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STC Program #4

Vol. I

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16. Abstract

This report describes the improvements which have been incorporated in the Streamtube Curvature (STC) Program to enhance both its computational and diagnostic capabilities. In Volume I, detailed descriptions are given of the revisions incorporated to more reliably handle the jet stream-external flow interaction at trailing edges. Also presented are the augmented boundary layer procedures and a variety of other program changes relating to program diagnostics and extended solution capabilities. Volume II consists of the updated User's Manual, and includes information on the computer program operation, usage, and logical structure.

User documentation includes an outline of the general logical flow of the program and detailed instructions for program usage and operation. From the standpoint of the programmer, the overlay structure is described. The input data, output formats, and diagnostic printouts are covered in detail and illustrated with three typical test cases. The program listing is included as a separate document (Volume II).

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SUMMARY

The Streamtube Curvature Program (STC) for prediction of the pressure distribution about a nacelle at transonic speeds was developed by the General Electric Company under contract number NAS1-10804. Experience with the use of the program has indicated the desirability of modifying the program to extend its capabilities and provide improved diagnostic information in the event of computational difficulties. This report is concerned with the improvements which have been incorporated in the STC program to enhance both its computational and diagnostic capabilities. In Part I, specific descriptions are given of the revisions to more reliably handle the jet stream - external flow interaction at trailing edges. Also described are the augmented boundary layer procedures and a variety of other program changes relating to program diagnostics and extended solution capabilities. Part II consists of the updated User's Manual, and includes information on the computer program operation, usage, and logical structure.

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Part I

DESCRIPTION OF PROGRAM MODIFICATIONS

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SECTION 1.0

INTRODUCTION

Aircraft have been designed with the NASA-developed supercritical wing to fly at cruise Mach numbers approaching one. The need for low installed drag and high drag-divergence Mach number nacelle installations is necessary to the success of this design. Design techniques are required to evaluate these nacelles on an isolated basis and then on an installed or integrated basis.

For this reason, NASA has initiated a program to provide design information for low drag, high drag-divergence Mach number isolated nacelles suitable for use with advanced high bypass ratio turbofan engines. One element of such a program is the development of a method to predict the inviscid pressure distribution and flow field about an arbitrary axisymmetric ducted body at transonic speeds. This prediction technique provides the means to conduct parametric studies so that the nacelle design criteria can be evaluated to select configurations for further experimental investigations. The prediction technique also provides guidance during wind tunnel testing to develop nacelle shapes which minimize drag within given design restraints.

The objective of the development of this computer analysis was the prediction of flow fields about isolated nacelles at transonic conditions. The solution technique has been further specified to give accurate results consistent with the requirement of relatively short computing time per input case as compared to that required for a time dependent finite difference method of solution. The method utilized to compute the flow field was developed under contract NAS1-10804 and is termed the Streamtube Curvature Relaxation technique (Reference 1).

The Streamtube Curvature (STC) method of solving external flows has not been discussed significantly in the literature; however, the method is a very natural one. For example, engineers frequently rely on one-dimensional compressible flow relationships for a first-order solution to ducted flows. The STC approach is similar except that a number of confluent streamtubes, with slightly different properties, are added together to obtain the total flow in the channel. Each streamtube is handled in much the same way as is the one streamtube in the one-dimensional problem. In the limit, as the size of the individual streamtubes approaches zero, the STC method satisfies the inviscid equations of motion exactly.

While this program is a basic tool for the calculation of the overall forces on nacelles, it is well understood that the effects of boundary layer friction drag and displacement of the inviscid flow must be included to obtain accurate performance predictions. The displacement of the inviscid

flow effectively changes the body shape, thus altering the inviscid pressure distribution. The summation of pressure-area forces taken over the body can be seriously in error when this displacement effect is not included. The coupling of a boundary layer solution with the inviscid STC analysis allows inclusion of displacement effects as well as a complete evaluation of all nacelle forces, including friction and the prediction of boundary layer separation.

The accumulation of running experience with the STC program has indicated the desirability of modifying the program to extend its capabilities, improve its reliability, and provide enhanced diagnostic information in the event of computational difficulties. The methods of analysis and the basic numerical procedures for computerization of the analysis are described in Reference 1. Part 1 of this report is concerned with recent modifications which have been incorporated in the STC program to provide the above cited improvements.

The computer program source deck for the updated version of STC, together with a user manual are available from COSMIC (Computer Software and Information Center), Burrows Hall, University of Georgia, Athens, Georgia, 30601. The program is written in CDC Fortran 2.3 source language, with exception of three subroutines in COMPASS 1.1 language. The computer program has been checked out for the CDC 6600 machine.

SECTION 2.0

MODIFICATIONS TO THE STC PROGRAM

In this section, the details of the improved procedures implemented in the STC program are presented. Information on the computer program operation, usage, and structure is described in the Users Manual (Part II). Since the bulk of the work involved specific program modifications, liberal references are made to this section of the report.

2.1 JET STREAM - EXTERNAL FLOW INTERACTION

To increase the accuracy of the STC calculation in the region of a trailing edge, the following improvements have been incorporated into the calculation procedure.

- When the total to static pressure ratios on both sides of a trailing edge are subcritical, it is necessary that the static pressure on the two sides of the trailing edge are matched. This is accomplished by an iterative adjustment of the flow rates, either on one or both sides of the trailing edge. The flow adjustment iteration logic was modified so that the flow adjustment is now performed in a separate iteration loop, and a record of the iterative adjustments is printed.
- When a supercritical total-to-static pressure ratio exists at the trailing edge, a Prandtl-Meyer expansion fan (or compression wave approximated by the Prandtl-Meyer formulas) is computed to define the local change in streamline angle and static pressure.
- The wake thickness distribution has been modified so that the wake displacement thickness provides a smooth transition between the blunt body and the "far" downstream flow field.

In the implementation of the new logic, three options have been provided for user selection. A description of these options will be provided in the discussion which follows.

First, however, to illustrate the nature of the flow in the trailing edge region, a fine grid calculation has been made for a low speed case in which the stagnation pressures of the flows above and below the trailing edge have been chosen to be unequal. Results for two levels of grid refinement are shown in Figures 1 through 4. As shown in Figures 3 and 4, a spike in pressure occurs due to the abrupt change in angle near the trailing edge. Although not quite predicted by the numerical procedure, the static pressure on the side with the lower total pressure (in this case the upper side) theoretically attains the stagnation value. At the trailing edge point on

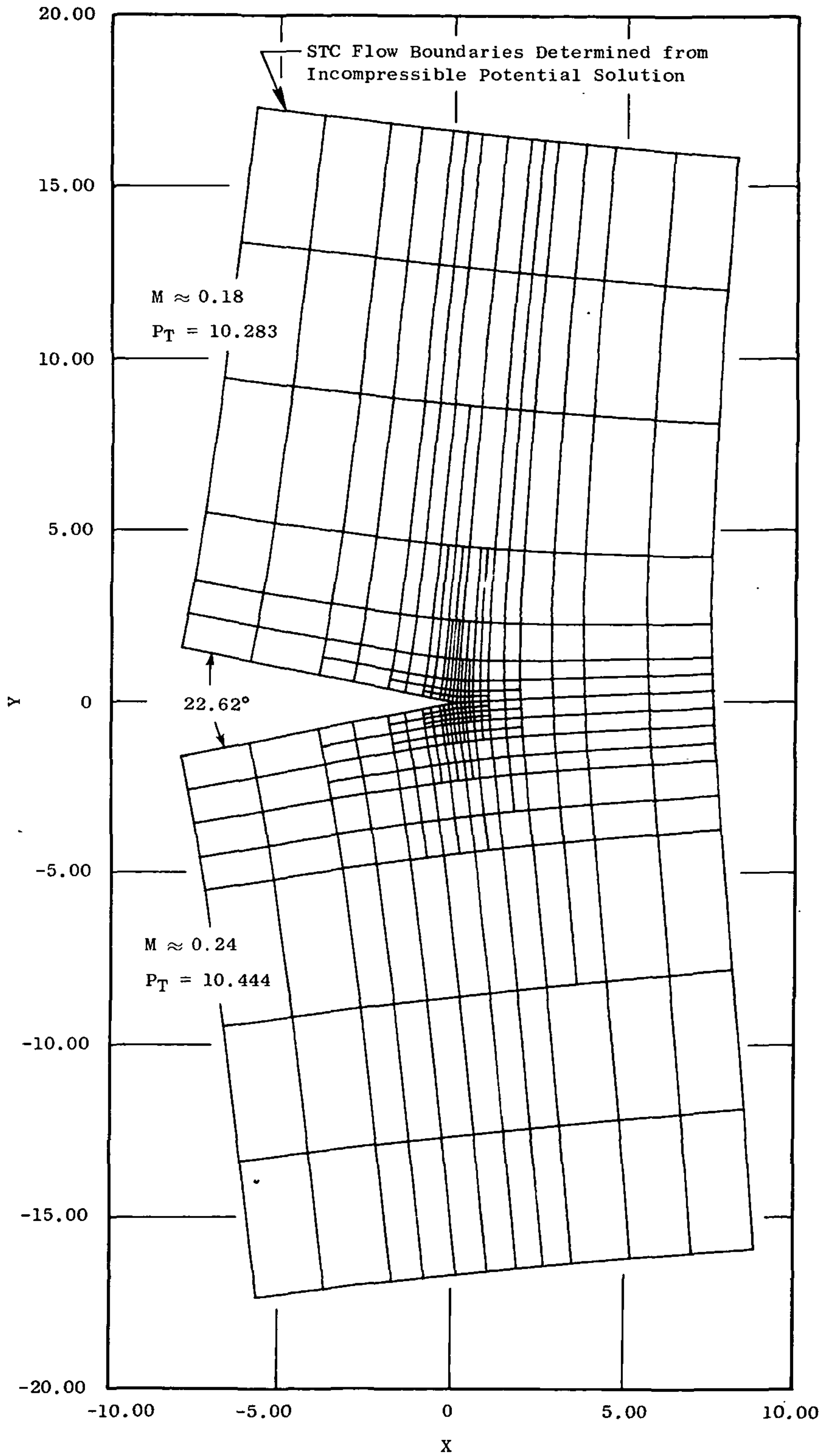


Figure 1. Calculation Grid for Detailed Sharp Trailing Edge Solution, 7 Grid Refinements.

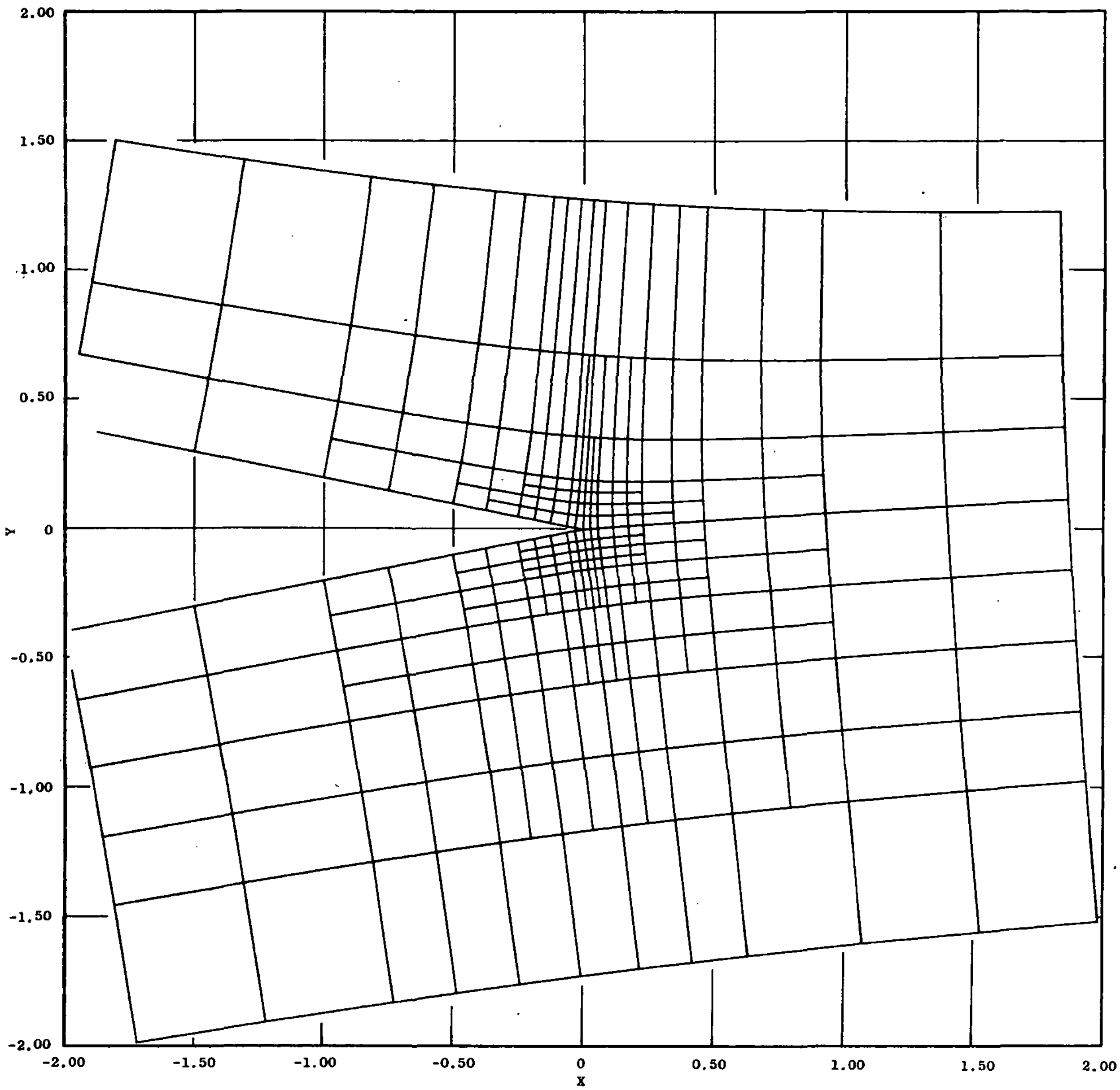


Figure 2. Enlarged Plot of Calculation Grid in Trailing Edge Region, 9 Grid Refinements.

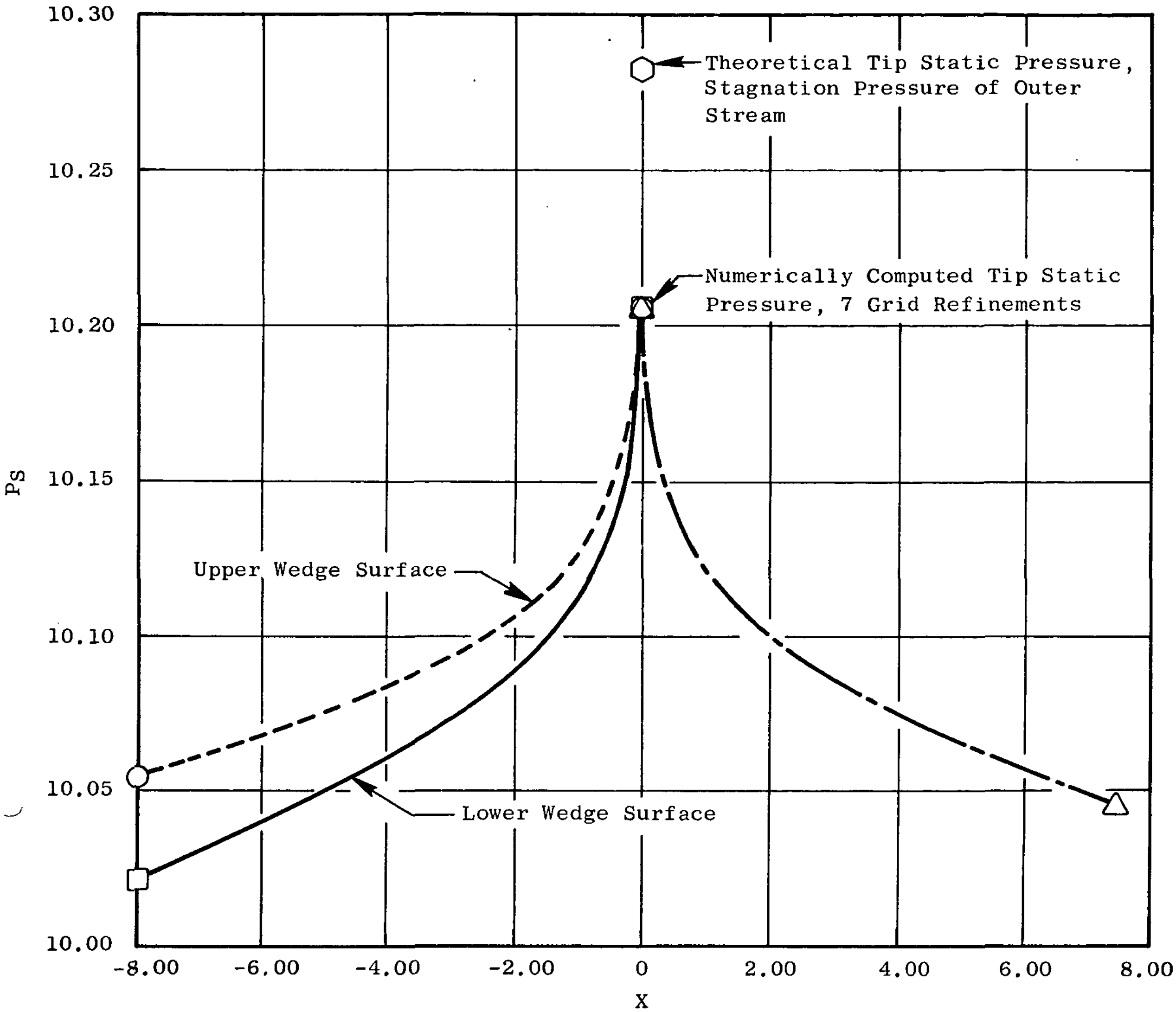


Figure 3. Static Pressure Distribution on Wedge Surface and Dividing Streamline, 7 Grid Refinements, Detailed Sharp Trailing Edge Solution.

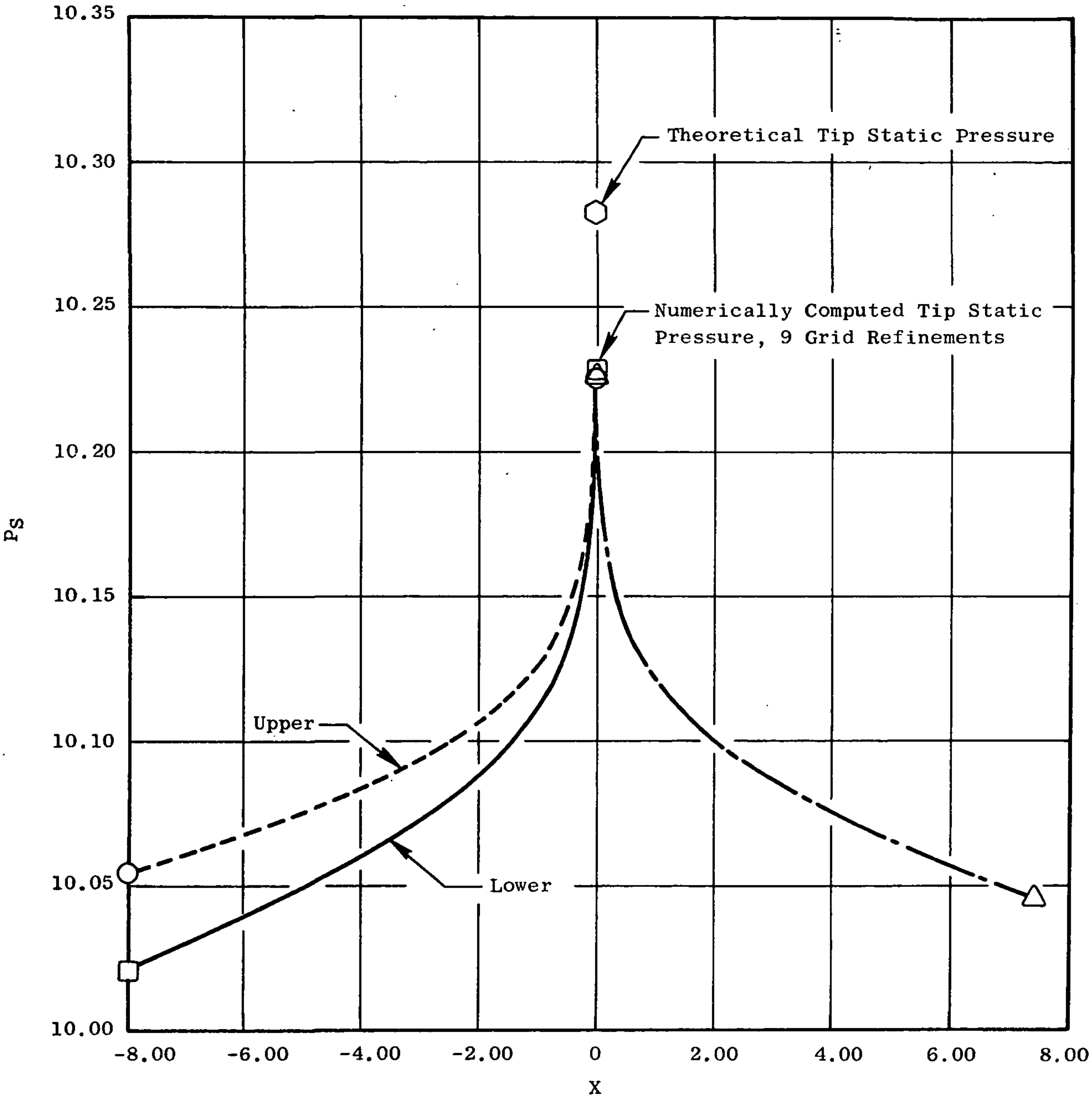


Figure 4. Static Pressure Distribution on Wedge Surface and Dividing Streamline, 9 Grid Refinements, Detailed Sharp Trailing Edge Solution.

the lower side, the static pressure will match that of the upper side in order to satisfy the "Kutta" condition. Consequently, because of the higher total pressure in the lower stream, the stagnation condition will not be obtained and the angle variation along the lower dividing streamline must be continuous as depicted in Figure 5. This detail, however, is so fine that it is not readily determined in the numerical solution. Figure 6 shows a plot of calculated angles.

This example helps to illustrate several interesting facts about trailing edge flow, namely:

- As is well known when the stagnation pressures are equal on both sides of the trailing edge, the trailing streamline bisects the trailing edge wedge and the flow stagnates at the tip on both sides of the trailing edge.

- When the stagnation pressure on one side of the wedge is somewhat higher than on the other side, the general character of the flow does not change markedly. Pressure spikes still occur on both sides of the trailing edge, although the theoretical flow solution is truely "singular" only on the side with the lower total pressure.

- The width of the spikes (i.e., the length of near-stagnated flow) is very narrow and would be even narrower for smaller wedge angles. The calculations shown were carried out for a 22.6° wedge angle.

The first of the trailing edge options now available in the STC program allows the user to select either the numerically computed or theoretically exact value of trailing edge pressure. This option, controlled by the input value of PDUM(2), applies only to sharp trailing edges and also applies only to the stream with the lower total pressure. The normal (or default) option is to print the theoretical (i.e., the exact) values of trailing edge tip pressure and to use these same values in the calculation of the axial pressure forces.

Figure 8 illustrates an example of a STC output when the theoretical value of the stagnation pressure is printed. The calculation grid for this example is shown in Figure 7a. These results may be compared to the alternate option of printing the (approximate) numerically computed values, Figure 9. The theoretical stagnation point condition on the upper side of the trailing edge generates a sharp downward spike in Mach number and an upward spike in pressure, Figure 8. Because the grid is relatively coarse, the high pressure region is averaged over a significant portion of the body and the error in the global momentum balance is large (20%). The global error is the sum of the entering momentum flux, the integrated axial boundary pressure forces, and the negative of the leaving momentum flux. These global errors are normalized by the axial pressure force along the respective wedge surface and slip line boundaries.

The "numerical" value of trailing edge pressure [PDUM(2)=0] shown in Figure 9 can be thought of as a representative average for the grid interval. Consequently, the computed global error is smaller.

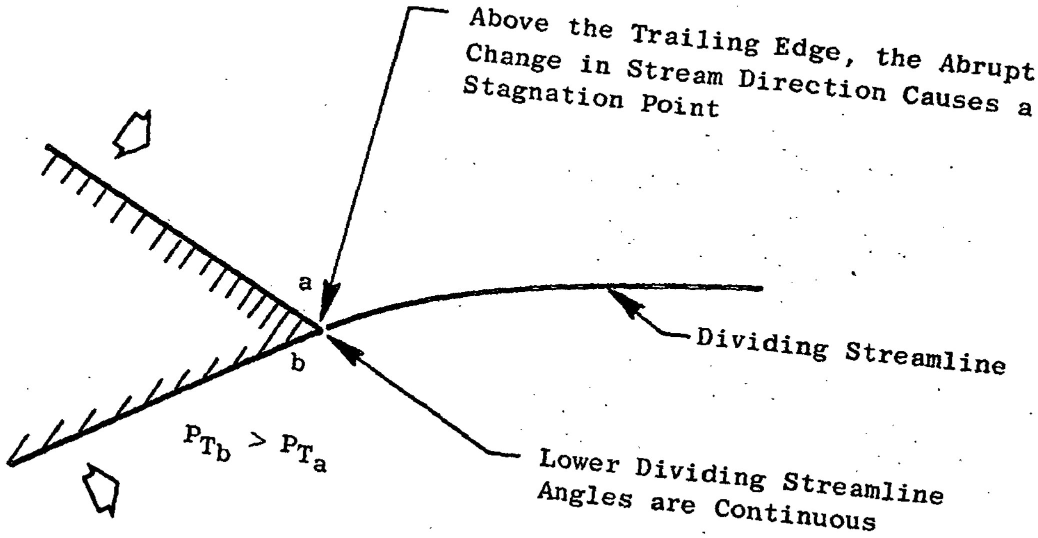


Figure 5. Ideal Trailing Streamline Shape for Unequal Total Pressures.

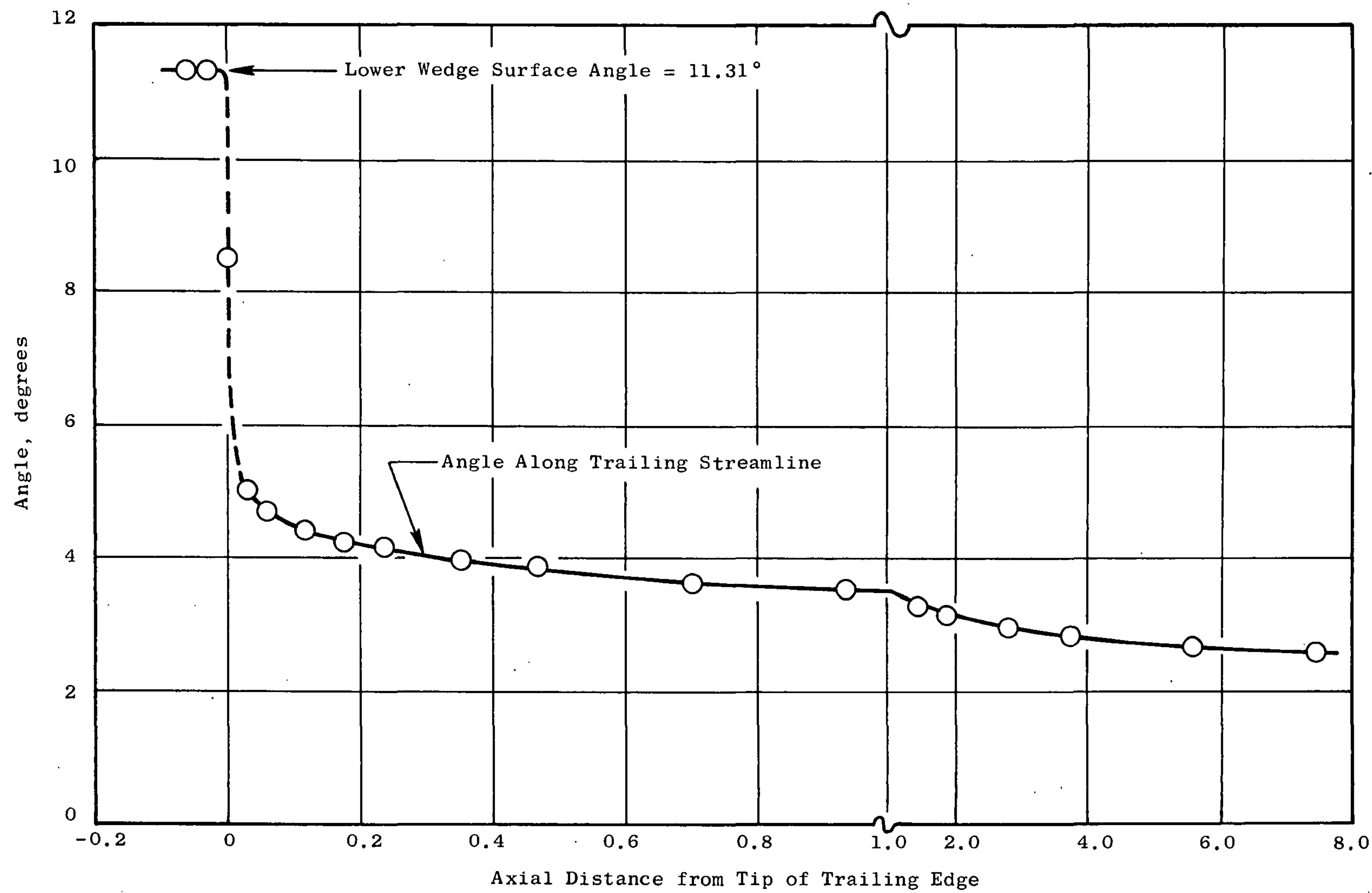


Figure 6. Trailing Streamline Angle Distribution, 9 Grid Refinements, Detailed Sharp Trailing Edge Solution.

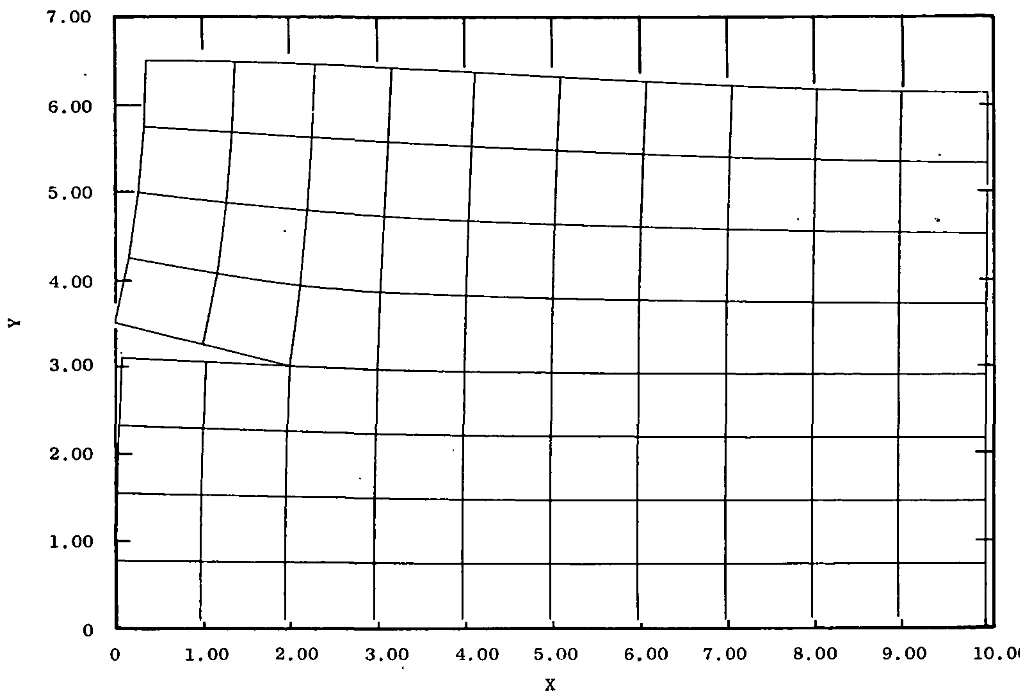


Figure 7a. STC Grid for Jet Stream-External Flow Interaction Test Calculation, Sharp Trailing Edge.

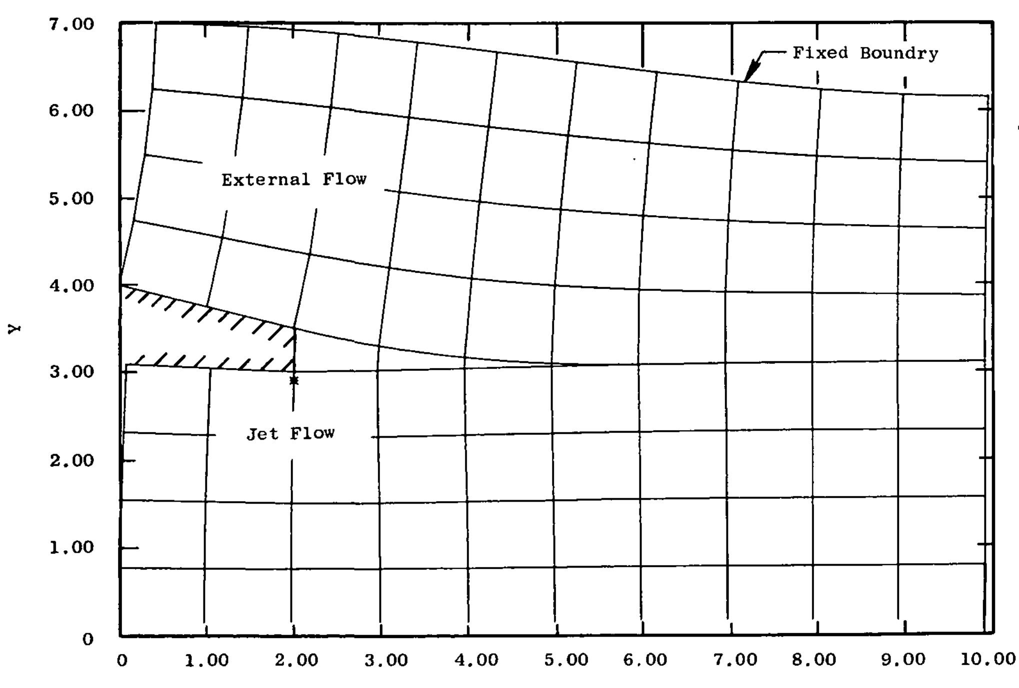


Figure 7b. STC Grid for Jet Stream-External Flow Interaction Test Calculation, Blunt Trailing Edge.

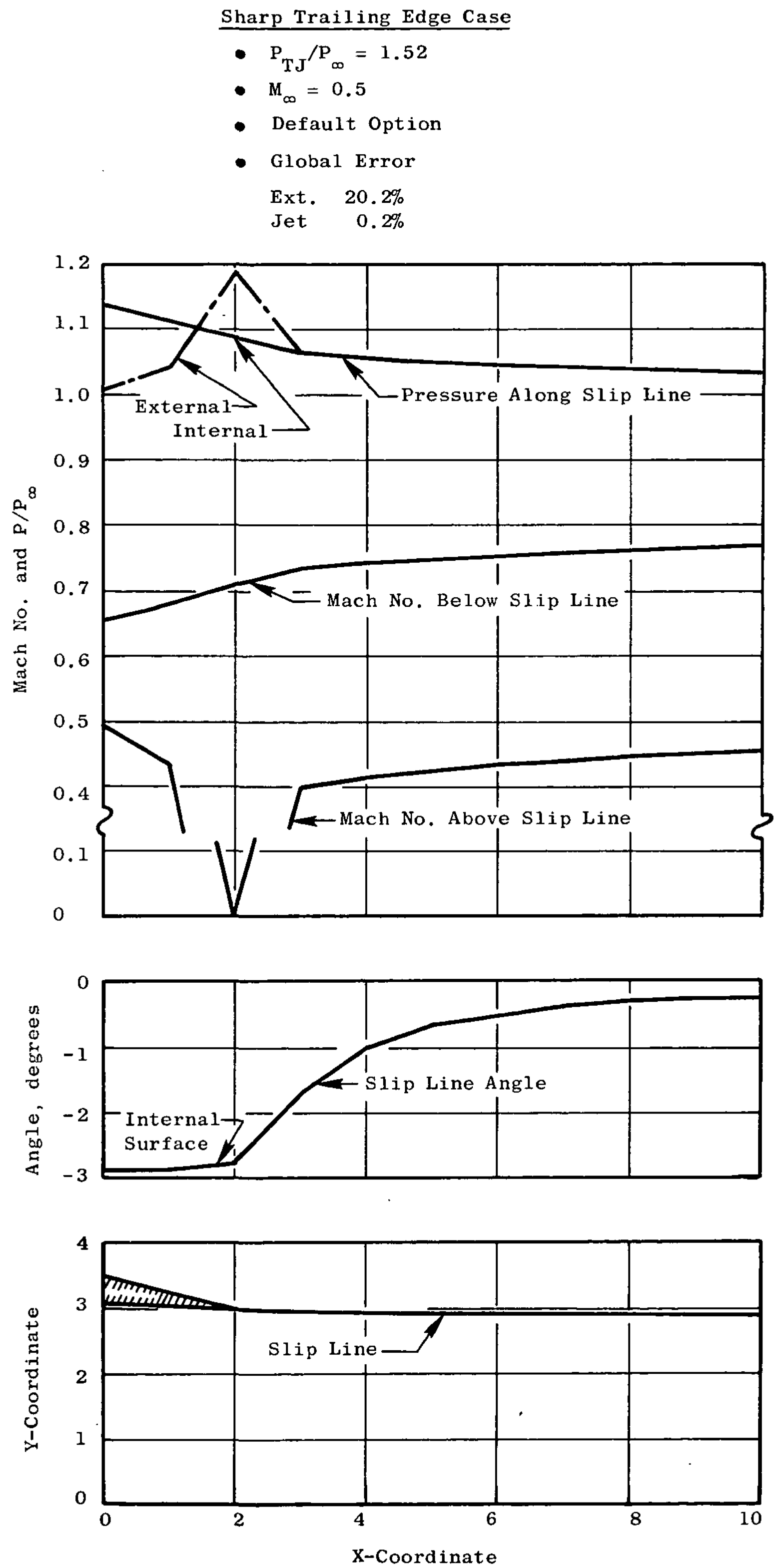


Figure 8. Mach Number, Pressure and Angle along Slip Line for Subsonic Jet Stream-External Flow Interaction.

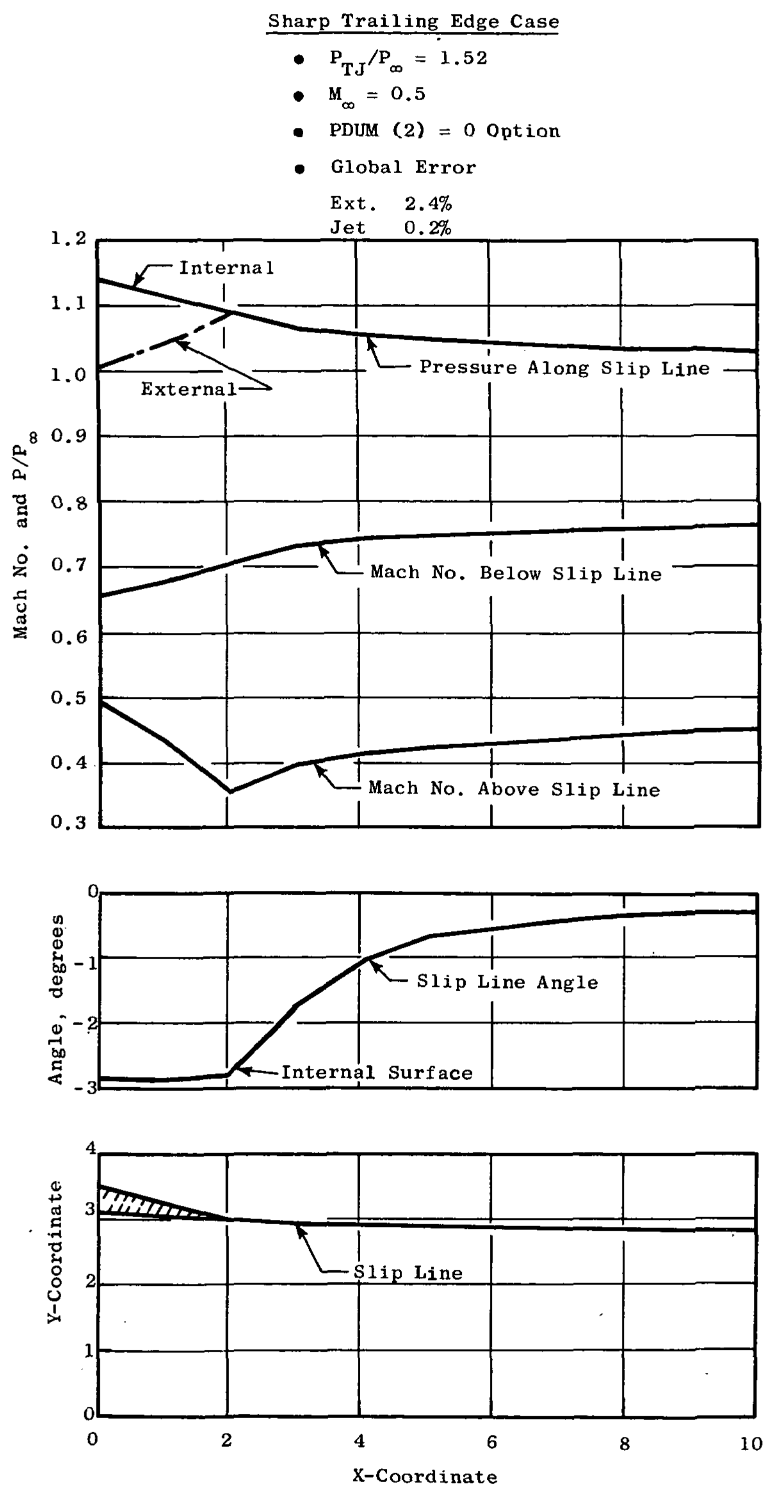


Figure 9. Mach Number, Pressure and Angle along Slip Line for Subsonic Jet Stream-External Flow Interaction.

2.1.1 Prandtl-Meyer Expansion Fan Calculation

In the STC algorithm a test is now made to determine if a Prandtl-Meyer expansion fan exists on either side of a trailing edge. For a convergent nozzle, this fan expands the flow from the pressure corresponding to unity Mach number to the pressure which is defined to exist on the other side of the trailing edge, P_e, shown in Figure 10. The theoretical value of P_e for a sharp wedge is the external stagnation pressure. Results obtained by using this option are shown in Figure 11. The alternate choice is to utilize the numerically calculated external pressure to define the Prandtl-Meyer expansion pressure, P_e, an example of which is shown in Figure 12. Except for the magnitude of the Mach number jump at the trailing edge, the solutions for the two options are not largely different. As stated earlier, this option applies only to sharp trailing edges. When the trailing edge is blunt, Figure 13, P_e is always taken as the numerically calculated external pressure.

2.1.2 Wake Thickness Calculation

The distribution of the wake thickness downstream of a blunt trailing edge has been changed from a linear to a quadratic form. The form used is:

$$b = b_\infty + (b_{t.e.} - b_\infty)\left[1 - \frac{x}{\ell_w}\right]^2 \tag{1}$$

where b is the local wake thickness, x is the distance along the wake centerline from the trailing edge and b_∞, $b_{t.e.}$ and ℓ_w are defined in Figure 14. This form has the advantage that the length, ℓ_w, can be chosen to provide a smooth continuation of the blunt body where, if the flow is subsonic, the wake edge streamline will be tangent to the effective body surface. Namely, at the trailing edge,

$$\left(\frac{db}{dx}\right)_{t.e.} = \tan\alpha \tag{2}$$

where α is the effective trailing edge wedge angle including the boundary layer displacement effects as shown in Figure 14. Differentiation of Equation (1) and substitution into Equation (2) gives:

$$\ell_w = \frac{2\ (b_{t.e.} = b_\infty)}{\tan\alpha} \tag{3}$$

Note that if the wake centerline is curved, the streamline tangency condition at the trailing edge may still be maintained. Also, for small wedge angles, $\tan\alpha > 0.1$, the wake length is limited to twenty "effective" trailing edge thicknesses.

PDUM (2) = 0: P_e = numerically calculated TE pressure

PDUM (2) = 1: P_e = total pressure of the external stream

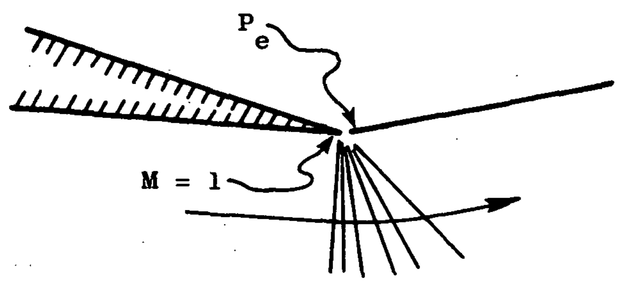


Figure 10. Options Available for Prandtl-Meyer Expansion Pressure, P_e.

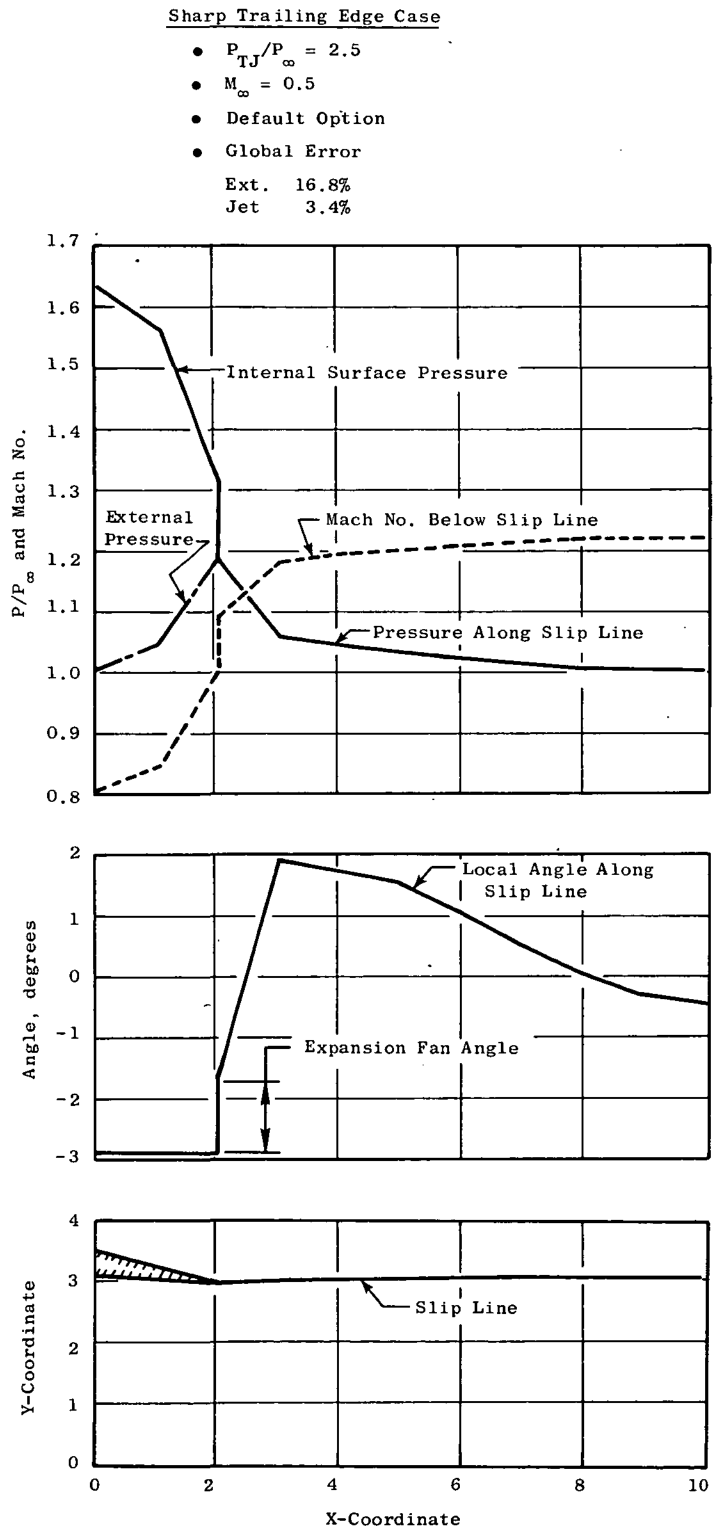


Figure 11. Mach Number, Pressure and Angle along Slip Line for a Supersonic Jet Stream-External Flow Interaction.

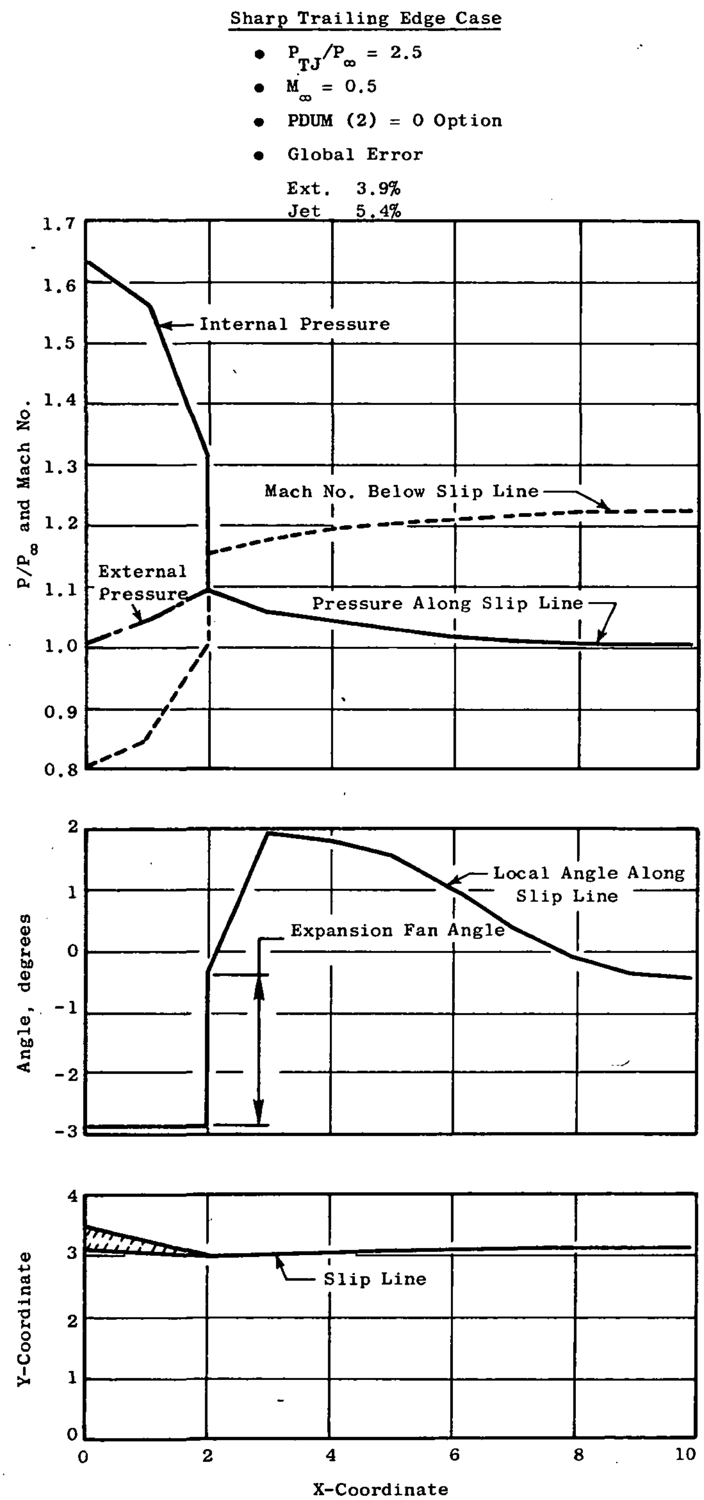


Figure 12. Mach Number, Pressure and Angle along Slip Line for a Supersonic Jet Stream-External Flow Interaction.

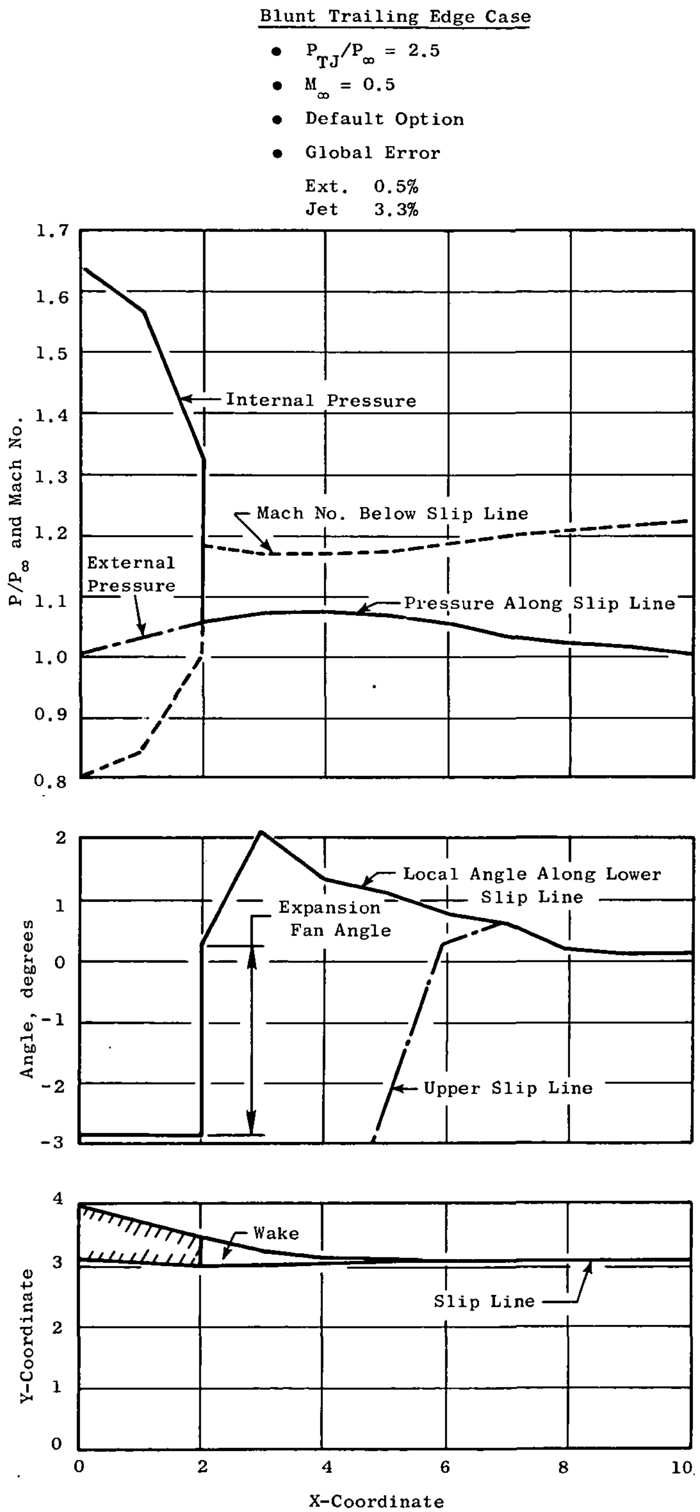
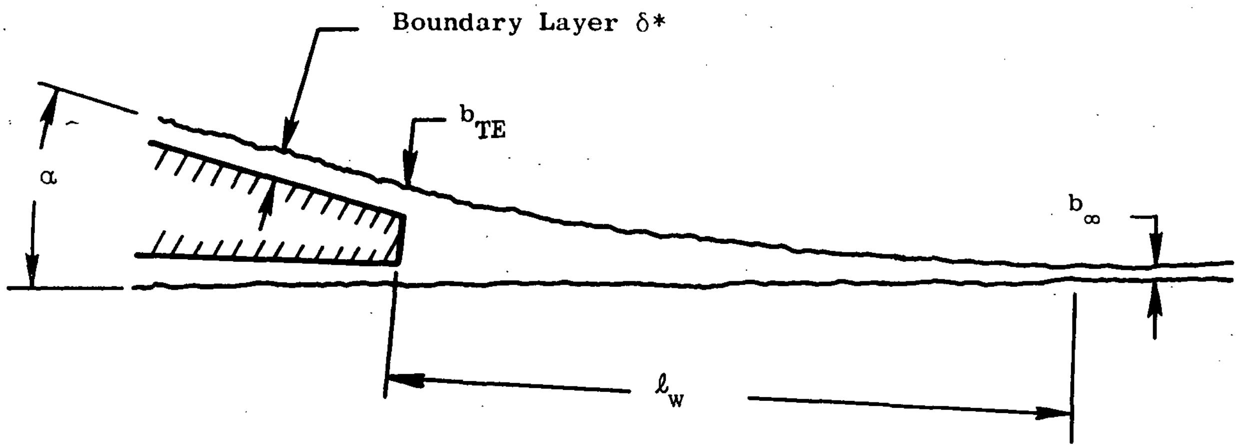


Figure 13. Mach Number, Pressure and Angle along Blunt Trailing Edge Wake for a Supersonic Jet Stream-External Flow Interaction.



$$\ell_w = \frac{2(b_{TE} - b_\infty)}{\text{Max}(\alpha,\ 0.1)}$$

Figure 14. Illustration of Parabolic Wake Thickness Distribution over Length, ℓ_w. (b_∞ is currently set to zero.)

Downstream of the wake length, ℓ_w, shown in Figure 14, a constant wake thickness, b_∞, is assumed. In the present procedure, b_∞ is taken as zero, but could be changed if desired. Far downstream of the trailing edge, it can be shown that the wake displacement thickness becomes equal to the momentum thickness. The momentum thickness is directly related to the friction drag and will not, in general, be zero. However, the effect of the finite versus zero downstream wake thickness on the body pressure distribution should be negligible for most cases.

When a Prandtl-Meyer expansion fan exists on one side of the trailing edge, the effective flow convergence angle, α, downstream of the expansion fan becomes larger, as indicated in Figure 15, and consequently the wake length is reduced. However, if the user wishes the wake length to be based upon the wedge angle upstream of the expansion fan, this may be enforced by inputting PDUM(3)=1.

2.1.3 Curvature at First Point Downstream of the Trailing Edge

Curvature at supersonic points is evaluated by fitting a parabola to the point in question plus the two upstream points. However, at the first point downstream of a trailing edge, this procedure is modified. The three pieces of information used to define the parabola are the two points, the trailing edge point and the point in question, and the angle at the trailing edge just aft of the Prandtl-Meyer expansion.

Again an option is provided to override this latter procedure, if desired, and to use the standard three point curvature formula even for points just downstream of the trailing edge. This is accomplished by setting PDUM(4)=0; an example result is shown in Figure 16. When compared to Figure 13, some differences may be noted in the angle distribution along the lower slip line. However, the differences in the computed pressure and Mach numbers are not large for this case. Presumably, they would become more significant for a refined grid.

2.1.4 Flow Adjustment Procedure

One of the important factors in establishing an accurate flow solution is the proper determination of the relative flow rates in the several passages or, expressed differently, the determination of the relative split between the flow which passes over and under an immersed body. When the flow is subsonic at the trailing edge, this flow split is determined by the condition that pressure at the tip of the trailing edge must be a single value; i.e., the two joining flows must have the same static pressure at that point. This rule may be applied to either sharp or blunt trailing edge cases (providing the flow is nearly stagnant behind the blunt edge) and to cases with finite boundary layer thicknesses.

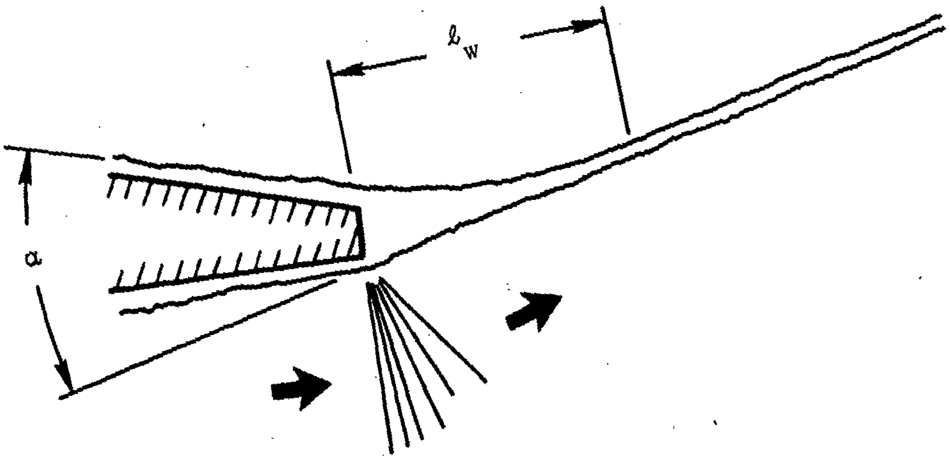


Figure 15. Reduced Wake Length Due to Expansion Fan.

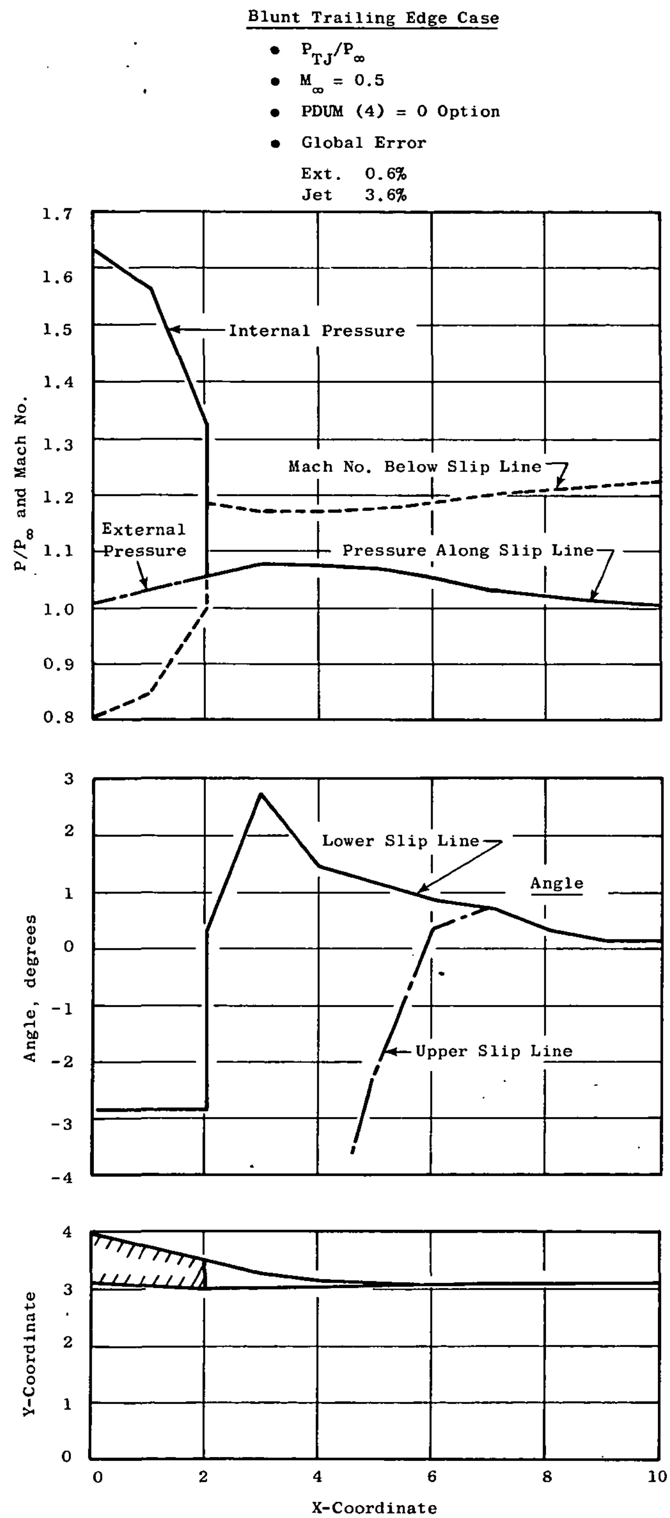


Figure 16. Mach Number, Pressure and Angle along Blunt Trailing Edge Wake for a Supersonic Jet Stream-External Flow Interaction.

As a word of caution, it should be noted that if the body shape is not well streamlined and a flow separation occurs upstream of the trailing edge, then the proper flow split can not be adequately determined. This is because a flow separation, which is not accounted for in the STC program, interacts with the inviscid flow and renders an accurate trailing edge static pressure prediction impossible.

As an example of the procedure followed to obtain pressure closure at the trailing edge, the flow rate iteration history for the Detailed Sharp Trailing Edge Solution (Figures 1 to 4) is shown in Figure 17. As illustrated, a flow iteration is performed for each grid refinement level. Errors which arise from an imbalance in trailing edge pressure are determined after the basic "inner" iteration tolerance is satisfied. The flow rate is then adjusted and additional inner iterations are performed, again, until the inner iteration tolerance is satisfied.

The trailing edge pressure closure error, plotted in Figure 17, is defined as fractional change in (the variable) flow rate necessary to achieve the same static pressure on both sides of the trailing edge. In this evaluation, the current distribution of streamline curvatures are used. (Of course, if the flow rate is changed, the streamline curvatures will then be somewhat in error, thus requiring additional inner iterations as mentioned above.) The user, through input specification, determines whether the channel flow rates above or below the trailing edge are to be varied to achieve the trailing edge pressure closure. If the flow rate in both the channels above and below the trailing edge are to be varied, the program will then hold the total flow constant and equal to the input value. (In this case, the flow rate shown in the "Kutta Iteration" printout is the flow rate below the trailing edge).

For completeness, it should be pointed out that the trailing edge static pressure used in the flow adjustment logic is always the numerically computed static pressure and not the theoretical stagnation value. This provides a consistent procedure for both sharp and blunt trailing edges, for both coarse and fine grid spacings, and for both equal and unequal total pressures of adjoining streams. (Notice that if the theoretical stagnation tip pressures were used for a sharp trailing edge in irrotational flow, then no pressure imbalance could be determined as a function of the flow split).

The above remarks apply to the case when the flow at the trailing edge is subsonic. If the flow is supersonic at the trailing edge, the static pressure equilibrium is obtained by an expansion fan or compression wave, whichever is appropriate. Furthermore, no pressure signal will be fed forward in this case to cause the flow rate to be changed.

In the jet stream-external flow interaction calculations shown in Figures 11, 12, 13 and 16, the jet flow rate was set by user input rather than by the adjustment procedure which is internal to the program. The jet flow rate was selected, by trial and error, to satisfy the criteria that the Mach number on the internal boundary trailing edge point (just upstream of

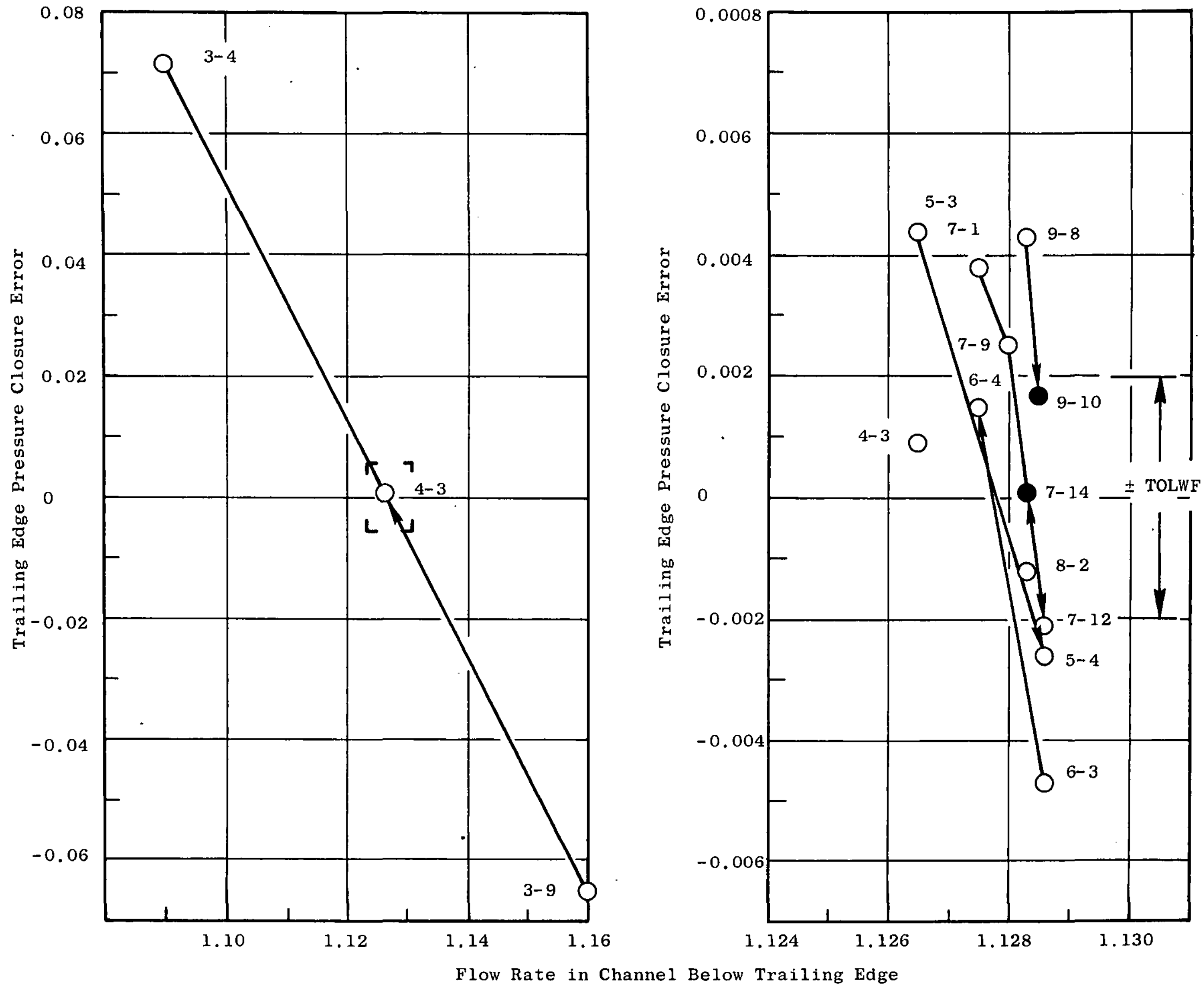


Figure 17. Kutta or Trailing Edge Pressure Closure Iteration for the Detailed Sharp Trailing Edge Solution. The Right Graph is Enlarged to Illustrate Final Detailed Adjustments. Numbers Beside Points are the Grid Refinement Level and Inner Iteration Counter for which the Closure Error was Evaluated.

the expansion fan) is unity. This was accomplished by changing the input value of the area, AO, which is used to compute the channel flow rate. The final selected value of AO was 2.99 corresponding to a flow coefficient of 99.7%. (Thus, the selected input for these cases was: PTO=25, TTO=1050, AO=2.99, MACHO=1.0, VARY=F. From these values and one-dimensional formulas, the channel flow rate computed by the STC program. The physical throat area was 3.0.)

A computerized procedure for calculating the choked flow rate is also available. In this procedure the maximum flow rate is found (for the "assumed" set of curvatures) which will pass through the known area. This procedure is valid for the throat station of a convergent-divergent nozzle, where the wall is curved and the flow is partially subsonic and partically supersonic. In the straight wall convergent nozzle, the latter procedure is not valid and must be suppressed, as indicated above, by setting VARY=F in the channel input data. Future additions to the STC program will be addressed to extending the algorithm for use with straight walled convergent nozzles.

2.1.5 Flow Field Convergence

For the calculation grid illustrated in Figure 7b typical iteration histories are shown in Figure 18. As indicated, the rate of convergence was found to be dependent upon the magnitude of the velocity jump in the slip line. For the highest jet pressure ratio of 5.2, convergence was not obtained.

A large number of runs were made with different "correction equation deceleration factors." For example, RHOC and RHOW were varied from .66 to 2.0. However, no significant improvement was obtained by the use of these factors. The use of the convergence factor CNVF was not tried.

Another factor which was found to greatly affect the convergence rate was the axial spacing of the calculations stations. Subdivision of the grid to half of the spacing shown in Figure 7 led to solution divergence.

The solution divergence was found to result from the omission of certain coefficient terms in the matrix equation for the streamline corrections. For flows with large vorticity, these terms become significant and, unfortunately, are not included in the present STC matrix solution procedure.

2.2 BOUNDARY LAYER REVISIONS

The basic boundary layer and separation calculation procedures defined in References 1 and 2 have been preserved intact in the current version of the program. Significant improvements, however, have been made in the implementation philosophy and the associated program logic which supports the boundary layer and separation calculations.

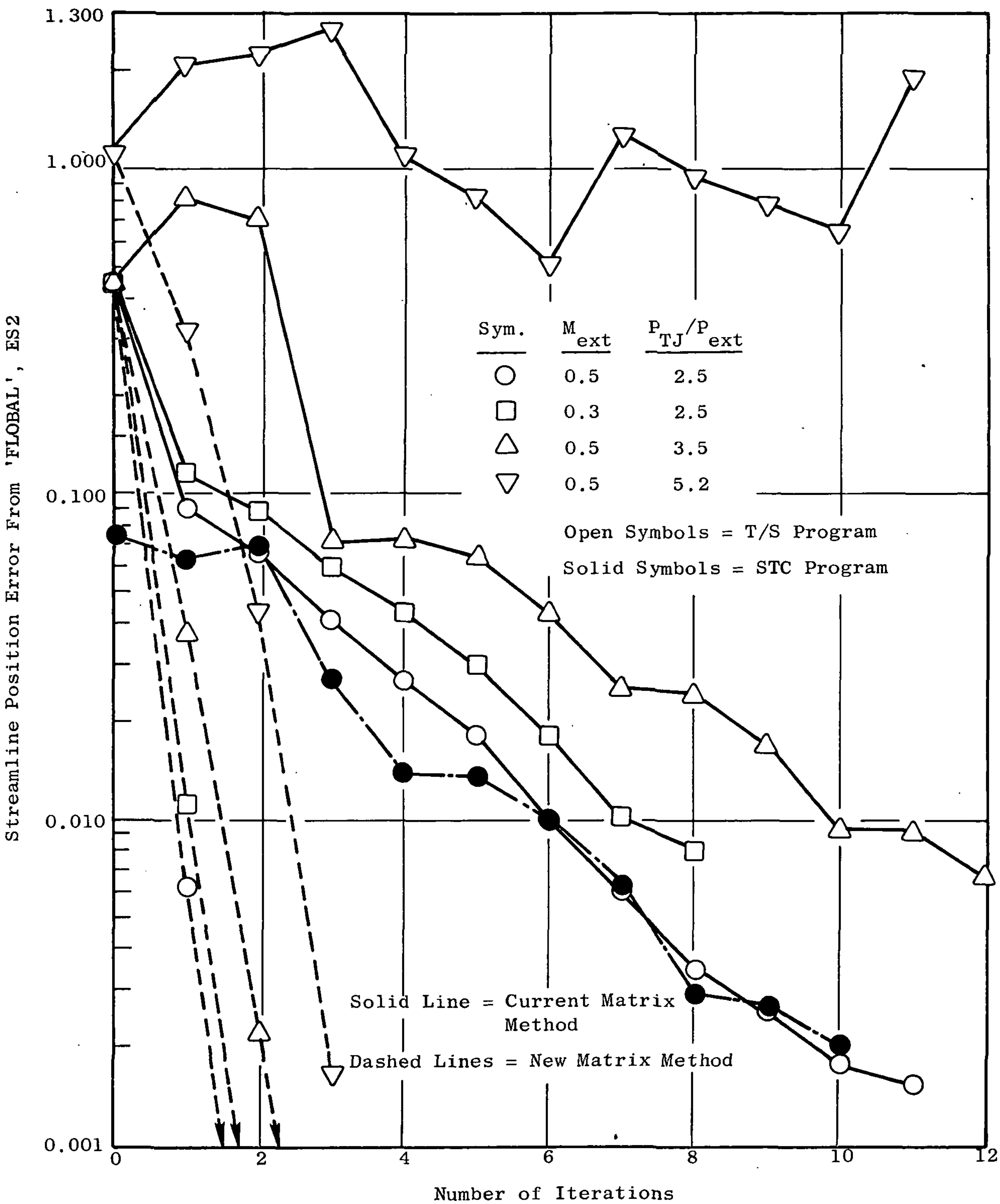
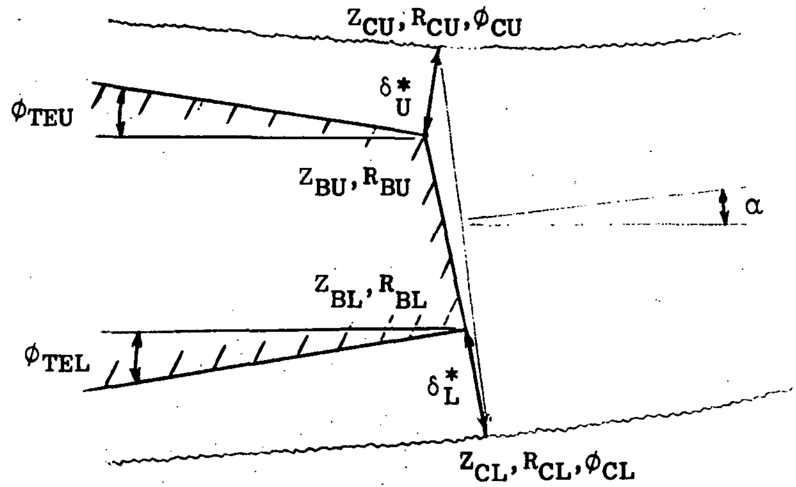


Figure 18. Convergence Histories for Supersonic Jet with External Flow using 8 Calculation Stations of the Grid shown in Figure 7b.

2.2.1 Wake Adjustment to Reflect Trailing Edge Boundary Layers

In the original version of STC, wakes were allowed to exist in the regions downstream of blunt trailing edges. The base regions enclosed by the wakes were gradually reduced to zero as the solution proceeded downstream. In the updated version, entries in the STC wake table are now initialized at all trailing edges rather than just at those which have a finite thickness. This modification permits a redefinition of the wake table to allow displacement effects at both sharp and blunt trailing edges.



Using the known surface geometry and the δ^* and $\frac{d\delta^*}{ds}$ from the boundary layer calculation, the displaced coordinates and angles are defined as:

Upper Surface

$$\phi_{CU} = \phi_{TEU} + \left.\frac{d\delta^*}{ds}\right|_U \tag{4}$$

$$R_{CU} = R_{BU} + \delta^*_U \cos \phi_{CU} \tag{5}$$

$$Z_{CU} = Z_{BU} - \delta^*_U \sin \phi_{CU} \tag{6}$$

Lower Surface

$$\phi_{CL} = \phi_{TEL} + \left.\frac{d\delta^*}{ds}\right|_L \tag{7}$$

$$R_{CL} = R_{BL} - \delta_L^* \cos \phi_{CL} \tag{8}$$

$$Z_{CL} = Z_{BL} + \delta_L^* \sin \phi_{CL} \tag{9}$$

$$\Delta R_C = (R_{CU} - R_{CL}) \tag{10}$$

$$\Delta Z_C = (Z_{CU} - Z_{CL}) \tag{11}$$

$$\alpha = \tan^{-1} \left[\frac{\Delta R_C}{\Delta Z_C}\right] - \frac{\pi}{2} \tag{12}$$

The effective wake thickness at the trailing edge is then:

$$t_{TE} = \sqrt{(\Delta R_C)^2 + (\Delta Z_C)^2} \cos \alpha \tag{13}$$

2.2.2 Initiation of Boundary Layers on Collated Boundary Segments

The STC program provides for definition of a boundary in discrete segments, where continuity of the surface is maintained by matching the coordinates and angles at the junction points of the segments. The resulting surface is then collated under a single boundary name internally for use by the program. For inlet configurations, with inner and outer contours joined at a stagnation point, the boundary segments are collated under the boundary name of the inner surface. In all other collation situations, the boundary is combined under the name of the first upstream segment.

Provision has been made in the STC program to allow the initiation of a boundary layer at the initial point of any collated boundary segment. For inlet geometries, this permits the user to run cases where the inner contour is "clean" and a boundary layer is calculated only on the external cowl surface. For boundary layers on surfaces which are segmented in the streamwise direction, additional information must be supplied to reflect the upstream history of the boundary layer (viz: δ^*, θ at the initial point). Within the STC program, the calculated boundary layer data are stored in a fixed length table area, along with other pertinent STC information (see Part II). When boundary layers are calculated on a large number of surfaces, the table area is often of insufficient size to permit storage of the boundary layer data. Using the above procedure to calculate boundary layers only on portions of given collated surfaces provides more effective use of the STC

table area. In this situation, care must be exercised when attempting to factor displacement effects into the inviscid solution, since boundary layer information is not available upstream of the initial point. The resulting discontinuity in displacement thickness on the boundary could conceivably induce undesired pertubations of the STC inviscid solution.

2.2.3 Separated δ^* Calculation

In the original version of STC, the boundary layer calculation was terminated if separation on a given surface was indicated. This condition caused several problems. Initially, the cumulative friction drag could not be calculated, since skin friction information downstream of the separation was not available. Finally, the boundary layer δ^* downstream of the separation point was assumed equal to the separated value. In general, this would tend to ignore the reattachment phenomenon and yield physically unreasonable values, particularly in both favorable pressure gradient zones and in the acceleration region downstream of a shock induced separation.

In an attempt to partially alleviate these situations, the boundary layer calculation is continued downstream after flagging the separation. While the numerical magnitude of the displacement thickness may be somewhat in question, it is anticipated that these procedures may be more representative of the true physical situation. Upon restart, a separated flow warning is still issued, as was done in the original implementation of the STC program.

2.2.4 Boundary Layer Initiation - Grid Refinement Level

An input option has been provided to allow initiation of a boundary layer at any predetermined level of grid refinement. In many cases, it is desirable to obtain a fully converged inviscid solution before introduction of the boundary layer. The new input option allows a staged solution of the problem using the "restart" feature with the final tolerance reduced on the last restart. The boundary layer calculation may then be carried out at this point. With the standard form of input, boundary layers must be specified at the beginning of the problem, and the calculation will occur prior to the execution of the restart cases. The details for this input option are given in Part II.

2.3 REVISED PROGRAM OUTPUT

Several major program changes have been made in both the standard output and in the diagnostic output which occurs when the solution encounters computational problems. The ultimate objective of these modifications has been to provide the user with a clear and concise definition of the solution so that the accuracy of the results may be rapidly accessed and solution problem areas may be easily located. Detailed descriptions of the new output are given in Part II. A brief description is included herein.

2.3.1 Iteration History

The parameters in the iteration history output have been altered to provide a more meaningful picture of the solution development. The items pertaining to the streamwise point movement have been eliminated. New output includes the coordinates of the point where the maximum flow balance error occurs. The algebraic sign of the maximum error has been retained so that the user may detect oscillation in sign as well as location in the field. The flow adjustment history at all trailing edges is now printed. This item includes the X12 location, the current flow rate, and the flow adjustment error as related to satisfaction of the "Kutta" pressure compatability condition at the trailing edge. The final new item of output is the number of imbedded supersonic points in the flow field. This parameter provides a useful indicator of what fraction of the field is transonic and often points to possible solution problems.

2.3.2 Diagnostic Format Revisions

The format of the diagnostic output, produced when solution problems occur, has been significantly revised. Specifically, the field tables are now printed in a tabular format to provide easier location of spurious curvature or velocity values. Also, a specific print of the ERASE2 temporary storage region is provided for each major calculation section of the program. All variables are identified by specific headings to locate critical parameters. A full description of this output is given in Part II.

2.3.3 Printer Plot

Following the processing of the input boundary data and the construction of the initial calculation grid, a one-page printer plot of the boundaries, primary orthogonals and streamlines is produced. Samples are given in Part II (Section 12.0). As indicated in these figures, the ξ_1-coordinates of the primary orthogonal lines and the ξ_2-coordinates of the dividing streamlines between channels are printed. The approximate locations of the boundaries are shown by plus signs. This allows convenient detection of gross irregularities in either the input boundary coordinates or the initial calculation grid. It also provides a map of the coordinate system which is a handy reference when examining the printout of the flow field solution.

2.4 REVISIONS TO PROMOTE SOLUTION RELIABILITY

To improve the starting reliability, three changes have been made in the computer code. First, the streamline positions are now computed at the zero-th refinement level. Second, the option for "constant density" calculation has been enhanced so that it may be used when far-field and pressure boundaries are present. Finally, stagnation points are not treated as singularities (with adjacent ISTAG=3 points) until a well defined grid has been obtained in the stagnation region.

Previously, before any calculations were performed to correct the initial guesses of the streamline positions, the grid was refined so that there would be at least one internal streamline within each channel and one intermediate calculation station between primary othogonals. (Primary orthogonals are defined in Section 3 of Reference 1). However, for cases where inlet or splitter leading edges were closely spaced in the streamwise direction, it was found that the initial grid was not sufficiently smooth for the interpolation required. Therefore, the equations for the streamline positions are now satisfied before this first refinement. Irregularities in angle and curvature of the stagnation and trailing streamlines are now smoothed and a satisfactory base for the first grid refinement interpolation is provided. (For the case of a single channel, the initial streamlines will entirely coincide with the boundaries and the streamline corrections will be trivial.)

Occasionally during the development of the grid in the early stages of refinement, an orthogonal will be located at a point on the boundary where the curvature is very large. Also, unrealistically high curvatures will be found within the field because the zero-th grid is based on a flow/area proportionality which causes kinks in the streamlines when an abrupt change in passage area (for example, a splitter vane) is encountered. When unrealistic curvatures exist over a sizable portion of the passage, the computed range in velocity will be very large and may give an indication of negative temperature ($V>V_{max}$) or passage choking. To alleviate this possibility, the grid may be partially refined by assuming that the density everywhere in the channel is equal to the stagnation density. With this assumption, choking cannot occur and (theoretically for incompressible flow) V_{max} becomes infinity so a negative temperature becomes inconsequential. This option is enforced by specifying a value of NODENS (see Part II) greater than (-1). For example, NODENS=3 will call for the constant density assumption to be utilized for the first three refinement levels. On the fourth refinement, the solution would revert to the full compressible equations. At this point, the streamlines will be smooth and the resolution will be adequate to assure that the difficulties mentioned above will not be encountered.

The default value of NODENS is zero. Therefore, the constant density approximation will be used for the zeroth grid solution unless the user specifies otherwise. This generally enhances the reliability of starting the STC solution except for high pressure ratio nozzle plume cases. In this case, the density level in the plume will be very different from the stagnation value and the use of the density option may retard convergence. Therefore, it is recommended that the default value of NODENS=0 be overridden by setting NODENS=-1 when a nozzle plume is being calculated.

The third feature now included in the program is to treat stagnation points as regular points until the grid becomes well defined. As such, a non-zero value of velocity will be computed at "stagnation points" by using a numerically evaluated curvature defined by a three point fit. The point is converted to a true singularity point (where the streamline curvature is infinite and the velocity zero) when the numerically evaluated velocity falls to one half of the velocity at the adjacent point (on the same orthogonal). This adjacent point is then converted to an "ISTAG=3" point and its

position and curvature is then interpolated. The advantage of this new procedure is that it avoids the interpolation of such points when the grid is very coarse and, consequently, when the interpolation can lead to unreasonable values. Through the approximate solution of the streamline position equations, the new procedure "ties down" these previously interpolated points when the stagnation region is not well defined, thereby enhancing operational reliability.

2.5 STRUT BLOCKAGE

To account for the blockage effects of struts, additional terms have been included in the program logic. Specifically, for axisymmetric flow, the effective flow area is defined as follows:

$$A = \int_C 2\pi r \lambda dS_2 \tag{14}$$

where S_2 is the distance along the orthogonal and λ is the blockage factor. For planar flow, the above equation reduces to

$$A = \int_C \lambda dS_2 \tag{15}$$

Thus, in the axisymmetric case, the value of λ is defined as the fraction of the unblocked circumference and is a value less than unity. In the planar case, λ is the depth of the channel or flow stream in the third dimension. Values of λ are input to the program defining the blockage at discrete points in a two-dimensional grid. The calculation grid point values are then obtained by linear interpolation.

2.6 DESIGN OPTION-ARBITRARY PRESSURE BOUNDARIES

In the version of the program described in Reference 1, provision was made for specifying a velocity along a far-field channel boundary. This capability allowed the numerically computed inner field to be matched to an economical, linearized far-field solution. In this case, the velocity from the far-field solution replaced the boundary condition that the last streamline coincide with a fixed contour. In the present version of the program, these procedures have been generalized to allow user input of an arbitrarily specified pressure or velocity over a portion of any boundary contour. An approximate boundary shape must be specified to provide for the development of the initial grid. After several grid refinements, the program boundary conditions are switched to utilize the specified distribution of boundary pressures.

The pressure may be specified on up to two separate boundaries. When a pressure boundary is specified along one boundary, the flow balance procedure uses the specified pressure to set the velocity level. (This replaces the iteration for the velocity level generally required to meet the known channel cross-stream area). If boundary pressures are specified along both channel boundaries the velocity on the upper boundary will dictate the cross-stream velocity levels (for the assumed curvatures) and an error will be computed in the lower boundary velocity. This velocity error is then included on the right hand side of the correction equation (at the lower boundary point) and during the course of the iteration will be reduced to zero. In Appendix A, the streamline position correction equation for the lower boundary is formulated. The upper boundary correction equation is the same as that used for far-field boundaries in the original version of the program.

When using this option to design to a desired velocity distribution, it is advisable to first calculate the velocity distribution for an approximate (or initial) contour and then select a region over which the pressure will be modified. In the end portions of this region, the newly specified pressures should be faired smoothly into the previously calculated values. If this is not done, the pressures on the fixed portions of the contour will change abruptly.

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Part II

USER'S MANUAL FOR STREAMTUBE CURVATURE PROGRAM

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SECTION 3.0

INTRODUCTION

Part II of this report consists of the Users Manual for the STC Program. Detailed descriptions are given of the structure of the computer program, Streamtube Curvature Analysis (STC), and the program usage and operation. The information given herein represents an updated version of the program and supercedes that included in References 3 and 4. Two types of information are included in this User's Manual: (1) user oriented input sheets and output definitions along with an example case, and (2) programmer oriented descriptions showing program structure, program nomenclature, program messages and error codes, and operating instructions. The program listing appears as a separate document (Volume II).

SECTION 4.0

PROBLEM DESCRIPTION

The Streamtube Curvature Analysis was formulated as a computer program to solve the inviscid equations of motion over a two-dimensional body (plane or axisymmetric) at transonic speeds. The computer program determines the flow field properties, streamlines, and pressure distribution over typical isolated nacelles and calculates the external pressure drag and the additive drag. (The additive drag is defined as the integral of pressure multiplied by the axial projection of the area taken along the entering streamtube from the undisturbed free stream conditions to the stagnation line on the cowl lip). The solution is the direct type in that nacelle shape, mass flows, and flight Mach number shall be the prime input data. A boundary layer procedure (SAB) is incorporated to allow evaluation of boudary layer displacement effects and friction drag as well as solution of the inviscid problems.

The computer program is capable of analyzing the following geometries:

a. Two-dimensional inviscid inlet problems without side spillage at zero or finite angle of attack.

b. Axisymmetric zero-angle-of-attack isolated nacelle problem with:

   1. Short cowl nacelle in which fan duct air of a turbofan engine exhausts upstream of the primary air nozzle, and the pressure distribution on the aft nacelle (waist cowl) must be determined.

   2. Long duct nacelle in which the exhausts of both streams are confluent at the exit or mixed upstream at the exit.

c. In all cases, the flow field may be calculated in the presence of a centerbody (or ramp) whose leading edge may be positioned either forward or aft of the cowl lip plane.

The flow field boundaries can be located as far upstream, and laterally displaced from the nacelle as far as practicable, to ensure minimum disturbances at the boundary and as far downstream as necessary to ensure correct nacelle trailing edge flow conditions. The program is capable of computing the inlet internal flow up to the assumed location of the engine face. The exhaust nozzle weight flow and aerothermodynamic properties of the exhaust flow shall be input quantities. The velocity of the exhaust may be sonic or greater.

The computer program is structured to allow user control of the fineness of the computational mesh. This allows selective grid refinement in the stagnation line region and in regions where high velocity gradients occur. The most useful deck utilizes 768 grid intersection points and requires a central memory storage of 115,000 octal locations.

The size of central memory storage required is a function of the defined table sizes. These table sizes may be changed to meet the user's needs. The method to change the table size is included in this User's Manual. Otherwise, the basic logic of the STC program is identical and all the capabilities defined above are always available.

The coding of the computer program meets the following requirements:

1. The program has been written to run on the LRC's CDC 6400 and/or 6600 computers, or any similar CDC 6400 and/or 6600.

2. The bulk of the computer program has been coded in CDC FORTRAN 2.3 language. Three subroutines have been coded in CDC Compass 1.1 language. The programs have been written to run under the SCOPE 3.1 operating system.

3. All input/output has been accomplished with CDC FORTRAN 2.3 statements. The standard system file names of INPUT for card reading and OUTPUT for printing have been used. In addition, input from tape files and output to tape files has been used.

The description of the capabilities of STC do not include all possible features that are included in the computer analysis. The user has control over the amount of grid refinement or computational mesh size, both by specifying local areas of mesh refinement and by setting the number of overall flow field refinements. The input geometry may be specified as coordinates only or coordinates and local surface angles on any boundary. Boundary layer effects may be selectively included for any surface and imposed at any level of grid refinement.

SECTION 5.0

METHOD OF SOLUTION

5.1 BASIC EQUATIONS

The following sections are concerned with the basic equations which are utilized in both the STC "inviscid procedure" and the coupled turbulent boundary layer (SAB) procedure.

5.1.1 STC

The STC Program is designed to solve the equations of motion along streamlines, Ψ = constant lines, and along lines which are orthogonal to the streamlines, ζ = constant lines. The variable ζ is introduced to avoid confusion with the velocity potential ϕ which is only applicable when the flow is irrotational.

Across the streamlines, the continuity and Crocco form of the momentum equation are written:

Continuity:

$$\partial A = \frac{\partial \Psi}{\rho V} \qquad (\zeta = \text{Const.}) \qquad (16)$$

Momentum:

$$\frac{1}{2}\frac{\partial (V^2)}{\partial n} = -\frac{V^2}{r_m} + \frac{\partial H}{\partial n} - T\frac{\partial S}{\partial n} \qquad (\zeta = \text{Const.}) \qquad (17)$$

Along the streamlines the following forms of the energy and momentum equations apply:

Momentum:

$$\frac{DS}{DS} = 0 \qquad (\Psi = \text{Const.}) \qquad (18)$$

Energy:

$$\frac{DH}{ds} = 0 \qquad (\Psi = \text{Const.}) \qquad (19)$$

where:

- A = Flow cross-sectional area = $2\pi\ r\ \partial n$
- C = Curvature of the streamline
- H = Stagnation enthaply
- n = Distance along the orthogonal
- p = Static pressure
- r = Radial coordinate
- S = Entropy
- s = Distance along the streamline
- T = Static temperature
- V = Velocity

Ψ, W = Stream function, cumulative flow rate

ρ = Density

The solution method is an extension of the conventional streamline curvature method. It may be briefly described as follows: First a crude grid of streamlines and orthogonal lines are assumed. (Please refer to Fig. 19. Second, the curvature of the streamlines at each of the grid points is evaluated. Third, the momentum equation is integrated along a line normal to the streamlines to obtain velocity and the continuity equation is integrated to determine the "correct" streamline positions (for the assumed curvature field). These are indicated by the "x" in Fig. 19. Fourth, an adjustment, ∂n, is computed by considering (1) the difference between the computed and assumed streamline positions and (2) the effect of the implied curvature modification in the integrated momentum equation. Finally, the streamlines are repositioned by the ∂n values.

Because the movement of any one grid point alters, through a change in curvature, the velocity at nearby points, it is highly desirable to account for these interrelating point adjustments simultaneously. The utilization of a simultaneous solution procedure, employed here, is not part of the classical streamline curvature method [5,6,7]. In comparison, the classical method yields calculation times which are very slow, especially for a closely spaced calculation grid. In concept, the set of simultaneous equations for the normal streamline adjustments are formulated from the finite difference equivalent of the following equations:

$$\frac{\partial^2(\partial n)}{\partial \Psi^2} + \frac{(1-M^2)}{(\rho V)^2}\,\frac{\partial^2(\partial n)}{\partial s^2} = F \qquad (20)$$

where:

δn = Required streamline adjustment in the normal direction

Ψ = Stream function

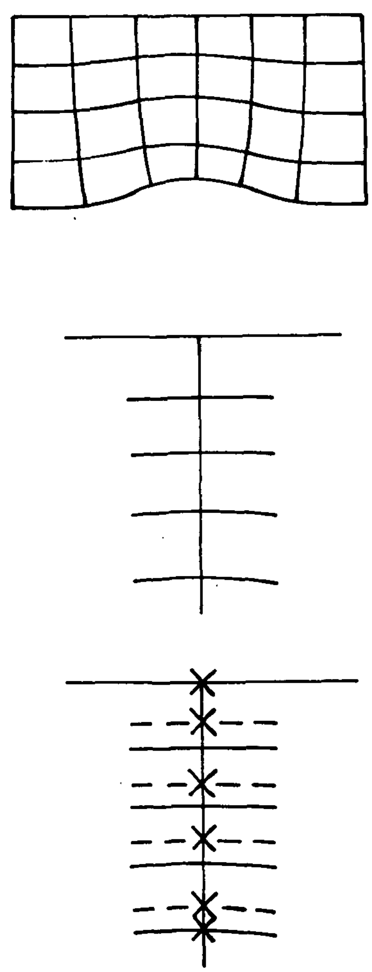
s = Curvilinear distance along a given streamline

M = Mach number

ρV = Flow per unit area

F = Driving (or error) function derived from the solution to the integral continuity and normal momentum equations.

This equation is derived in (Ref. 1) for the special case of isentropic 2-dimensional flow. (These limiting assumptions are utilized only to maintain simplicity of illustration; they are not part of the computer program). From a mathematical point of view, the above equation is similar to the conventional equations for velocity potential or stream function, namely,



1. Assume a Crude Grid

2. Evaluate Curvature

3. Integrate The Cross-stream Momentum Eqn. and Continuity Eqn. To Determine The "Correct" Streamline Positions.

4. Solve The Matrix Equation for δn and Move The Grid Points.

Figure 19. Solution Technique.

$$(1-M_y^2)\frac{\partial^2\phi}{\partial y^2} - 2M_xM_y\frac{\partial^2\phi}{\partial x\partial y} + (1-M_x^2)\frac{\partial^2\phi}{\partial x^2} = 0 \qquad (21)$$

$$(1-M_y^2)\frac{\partial^2\Psi}{\partial y^2} - 2M_xM_y\frac{\partial^2\Psi}{\partial x\partial y} + (1-M_x^2)\frac{\partial^2\Psi}{\partial x^2} = 0 \qquad (22)$$

x and y are coordinates in a two-dimensional rectangular system and ϕ and Ψ are the velocity potential and stream function, respectively. (Again, all of the equations have been restricted to isentropic flow for illustration).

However, for the purpose of calculating transonic flow, the use of Eq. (5) offers a distinct advantage over Eqs. (21) or (22) for the following reason: Because the grid is always aligned in the streamline and normal to streamline directions, no cross-derivatives appear. In consequence, the finite difference star is simply switched from a subsonic representation to a supersonic representation illustrated in Fig. 20.

Notice that for supersonic flow, no points downstream of the orthogonal line are included. This reflects the physical reality that disturbances downstream will not affect the flow upstream. It is, of course, because the coefficient term, $(1-M^2)$, passes through zero and changes sign that the star-switching noted in Fig. 20 is appropriate.

If the grid system is not aligned with the flow direction, a cross derivative appears in the equation, as in Eq.(20). Unfortunately, the mixed derivative coefficient, M_xM_y, does not have the same sign change property and, therefore, star-switching with this equation is more difficult for general flows with some angularity.

The extended streamline curvature method, here referred to as the Streamtube Curvature (STC) method, has then the following features.

- No additional complexities arise when the flow is rotational.
- The slip lines between the exhaust jet and the external flows can be handled precisely. (The procedure is to consider two coincident streamlines. Their position and pressure are the same; their velocity and stagnation properties may be different).
- From a numerical point of view, the streamline/orthogonal line oriented grid facilitates the analysis of transonic fields, as described above.
- The streamline/orthogonal line grid also provides a mapping of the flow field into a rectangular domain. This is helpful from the standpoint of computer program organization.

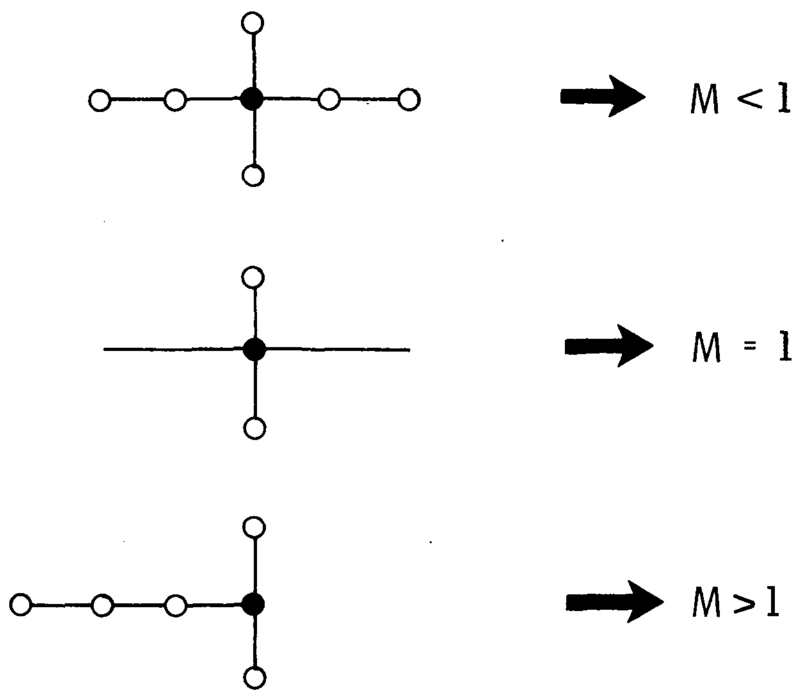


Figure 20. Finite Difference Stars for Subsonic and Supersonic Flow.

- Boundary layer displacement effects are easily included by coupling the STC inviscid solution with a turbulent boundary layer procedure.

The STC Program has also been designed

- to handle multiple streams,
- to adjust the flow rates of the jet exhaust streams to meet the "Kutta" condition at trailing edges or the (2-dimensional) choking condition,
- to place grid points at locations in the flow field where they are needed, as determined by local variations of the dependent variables, and
- to allow external flow analysis by incorporating matched near-field and far-field solutions. The far-field solutions are obtained analytically, utilizing small perturbation theory.

5.1.2 SAB - (Turbulent Boundary Layer)

The boundary layer procedure coupled with the STC inviscid solution is the method of Stratford and Beavers (SAB) described in detail in References 1 and 2. In the SAB method, the integral boundary layer parameters θ, δ^*, δ are expressed in closed form as a function of Mach number, equivalent flat plate length, and Reynolds number based on the equivalent flat plate length.

$$\begin{bmatrix} \Theta \\ \delta^* \\ \delta \end{bmatrix} = f(M) \text{ X } Re_x^{-b} \qquad (23)$$

The equivalent flat plate length in the above expression is defined as the length over which a boundary layer growing on a flat plate at the given Mach number would acquire the same thickness as the real boundary layer at that given location. For axisymmetric or plane flow

$$X = \frac{1}{Pr^a} \int_{Sw_1}^{Sw_2} Pr^a dSw \qquad (24)$$

where = Sw = distance measured along the wall

$$a = \frac{1}{1-b} \quad \text{Axisymmetric}$$

$$a = 0 \quad \text{Plane}$$

$$P = \left[\frac{M}{(1+.2M^2)}\right]^4$$

The specific working formulas for calculation of the integral parameters are as follows:

For $10^6 \leq R_x \leq 10^7$

$$\Theta = 0.036\ (1+.1M^2)^{-0.7} \times R_x^{-1/5} \tag{25}$$

$$\delta^* = 0.046\ (1+.8M^2)^{0.44} \times R_x^{-1/5} \tag{26}$$

$$\delta = 0.37 \times R_x^{-1/5} \tag{27}$$

For $10^7 \leq R_x \leq 10^8$

$$\Theta = 0.022\ (1+.1M^2)^{-0.7} \times R_x^{-1/6} \tag{28}$$

$$\delta^* = 0.028\ (1+.8M^2)^{0.44} \times R_x^{-1/6} \tag{29}$$

$$\delta = 0.23 \times R_x^{-1/6} \tag{30}$$

With these relations, the distributions of $\theta(S_w)$ and $\delta^*(S_w)$ can be calculated, given the boundary layer edge pressure or velocity distribution form STC. The local skin friction coefficient for determination of the friction drag is evaluated numerically using the integral momentum equation.

$$C_f = 2\frac{d\Theta}{dS_w} + \frac{2}{V}\frac{dV}{dS_w}(2\Theta+\delta^*) + \varepsilon\frac{2}{r}\frac{dr}{dS_w} + \frac{2\Theta}{\rho}\frac{d\rho}{dS_w} \tag{31}$$

$$\text{where } \varepsilon = \begin{matrix}\text{o Plane flow}\\ \text{1 Axisymmetric flow}\end{matrix}$$

Boundary layer separation is detected during the calculation by evaluation of the Stratford separation parameter (Reference 23). This quantity is defined as:

$$F = \bar{C}_p\left[S_w\frac{d\bar{C}_p}{dS_w}\right]^{1/2}\left[10^{-6}\ Re_x\right]^{-0.1} \tag{32}$$

$$\text{where } \bar{C}_p = 1 - \frac{M^2}{M_1 2}$$

and M_1 is evaluated at the minimum pressure point of an adverse pressure gradient region

The Stratford parameter is only calculated in a region of adverse pressure gradient $(dP_w/dS_w)>0$. The distance along the surface is taken as the distance from the beginning of the adverse pressure gradient region, and M, is evaluated at the minimum pressure point. For practical purposes, separation is assumed to occur if F attains a value of 0.5 or greater. The calculation continues beyond the separation point, but the separation point and all values downstream are flagged in the boundary layer output and the STC output if the problem is restarted to include displacement effects.

5.2 AN OUTLINE OF THE CALCULATION SETUPS

The operations performed by the STC Program may be outlined as follows:

1. Define the flow regions and locate (approximately) the "primary" orthogonals and the streamlines which divide the internal and external flows.

2. Refine the grid as required by inserting additional streamlines and orthogonal lines between those already existing.

3. Compute the streamline angles and curvatures.

4. Compute the orthogonal line angles and move the grid points along the streamlines to obtain orthogonality.

5. Compute the velocities on the "far-field" boundary.

6. Adjust the flow rates in the exhaust streams, if any, to meet the calculated choking flow rate.

7. Integrate along each orthogonal the momentum and continuity equations [Eqs. (16) and (17)].

8. If the streamline positions are within a "rough tolerance", adjust the flow rate of variable flow channels to meet the "Kutta" condition at trailing edges. Step 7 is repeated with each iterative adjustment of the flow rates.

9. If the streamlines are within tolerance, return to Step 2 for additional grid refinement (unless grid refinement limits have already been reached). Otherwise, continue to Step 10.

10. Determine if the streamline positions are within final tolerance. If so, jump to Step 14. Otherwise continue to Step 11.

11. Set up the matrix equation for the streamline correction, δn.

12. Solve the matrix equation.

13. Modify the streamline position by δn, and return to Step 3.

14. Calculate and print the output quantities; calculate boundary layers and adjust wake table at trailing edges; then return to Step 1 for the next case, if any.

The first operation includes reading the card input for a description of the geometry and flow properties. The computer program has been written to have general capability for analyzing a great variety of configurations. The first step in the programmed logic is to develop a table of orthogonals or calculation stations for each of the several flow regions. The regions are determined as illustrated in Fig. 21 so the calculation can proceed from upstream to downstream. The boundary of each region is defined as a primary orthogonal. As shown in Fig. 22, the initial grid which is developed contains only the primary orthogonals and the double streamlines which separate the various streams. A full inner iteration is carried out at this point to improve solution reliability at later stages of grid refinement.

The second step in the computational procedure is the grid refinement. The very crude grid, obtained in Step 1, is refined before the second solution of the flow field equations is executted. A new orthogonal is placed within each region and, likewise, a streamline is inserted in the middle of each channel. In the external channel, additional streamlines are placed close to the body. After the solution has been obtained for this net, the grid intervals are halved as required. This may be likened to the steps taken when one "flux plots" a flow field by hand. First, major flow lines and normals are sketched in, and then more and more streamlines and orthogonal lines are added until the desired resolution is obtained. At each step in the process the positions of the lines are adjusted to meet the correct solution requirements. The procedure automatically provides for grid refinement in regions of high curvature and high acceleration or deceleration. The streamline and orthogonal lines which are added between existing lines are not required to span the field if only local refinement, near the body, is required. The refinement procedure presently built into the program uses a criteria involving the distance and velocity increment between grid points. These refinement criteria are discussed in detail in Sections 11 and 13.

The third step in the method is to determine the angles and curvatures of streamlines at each grid point. For subsonic portions of the flow field this is performed by fitting a piecewise continuous cubic polynominal in a coordinate system which is locally rotated for each interval. The resulting fit is analogous to the curve produced by a beam which is loaded by discrete forces so as to pass through the given grid points. The locally rotated coordinate system removes the restriction that requires the slope to be small. For grid points located in a supersonic region, backward difference formulas are employed. Either 3-point, 4-point, or 5-point formulas may be optionally selected. Again the coordinate system is rotated so that slopes in the curve fitting coordinate system are small.

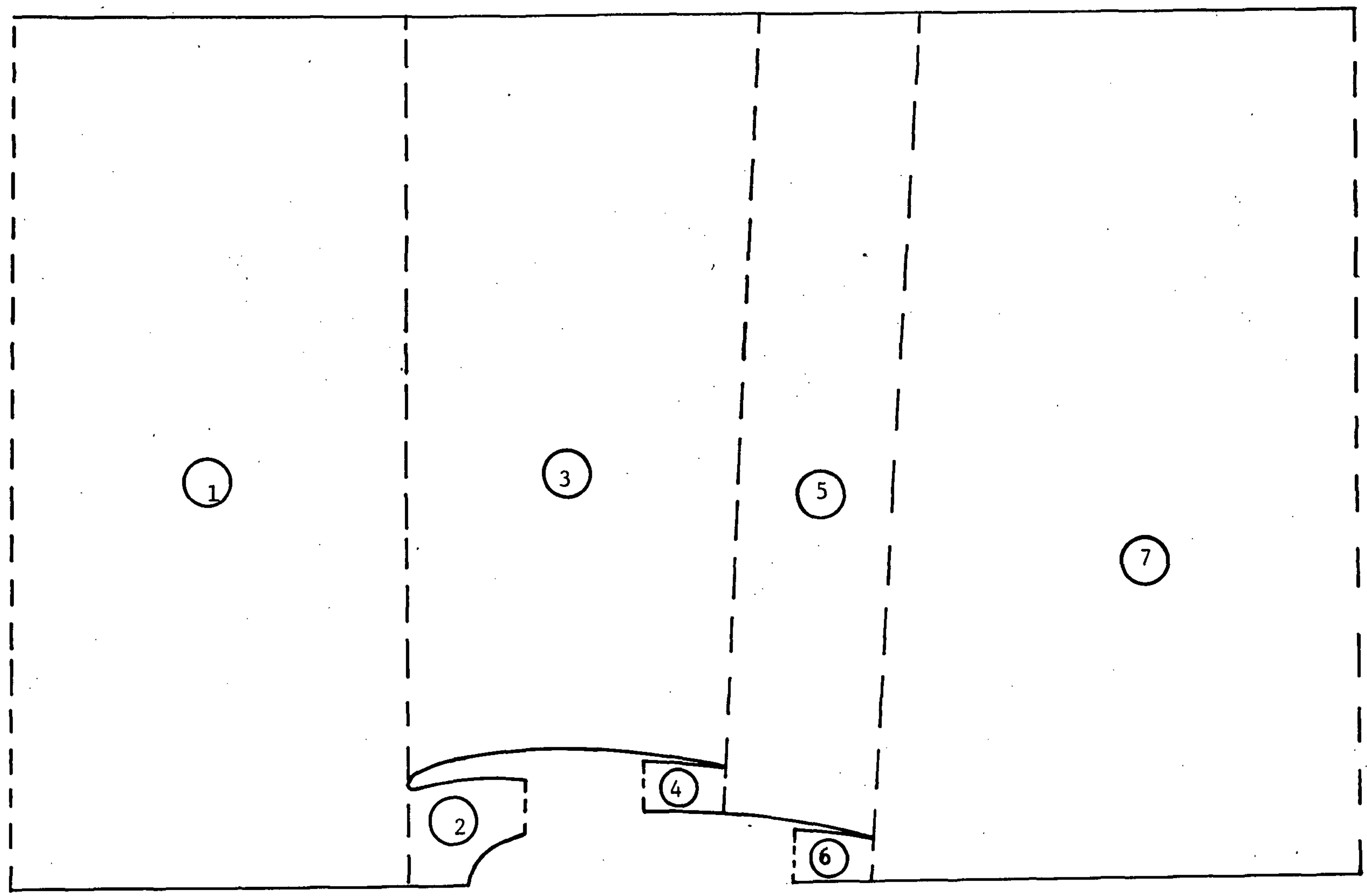


Figure 21. Subdivision of the Flow Field into Regions.

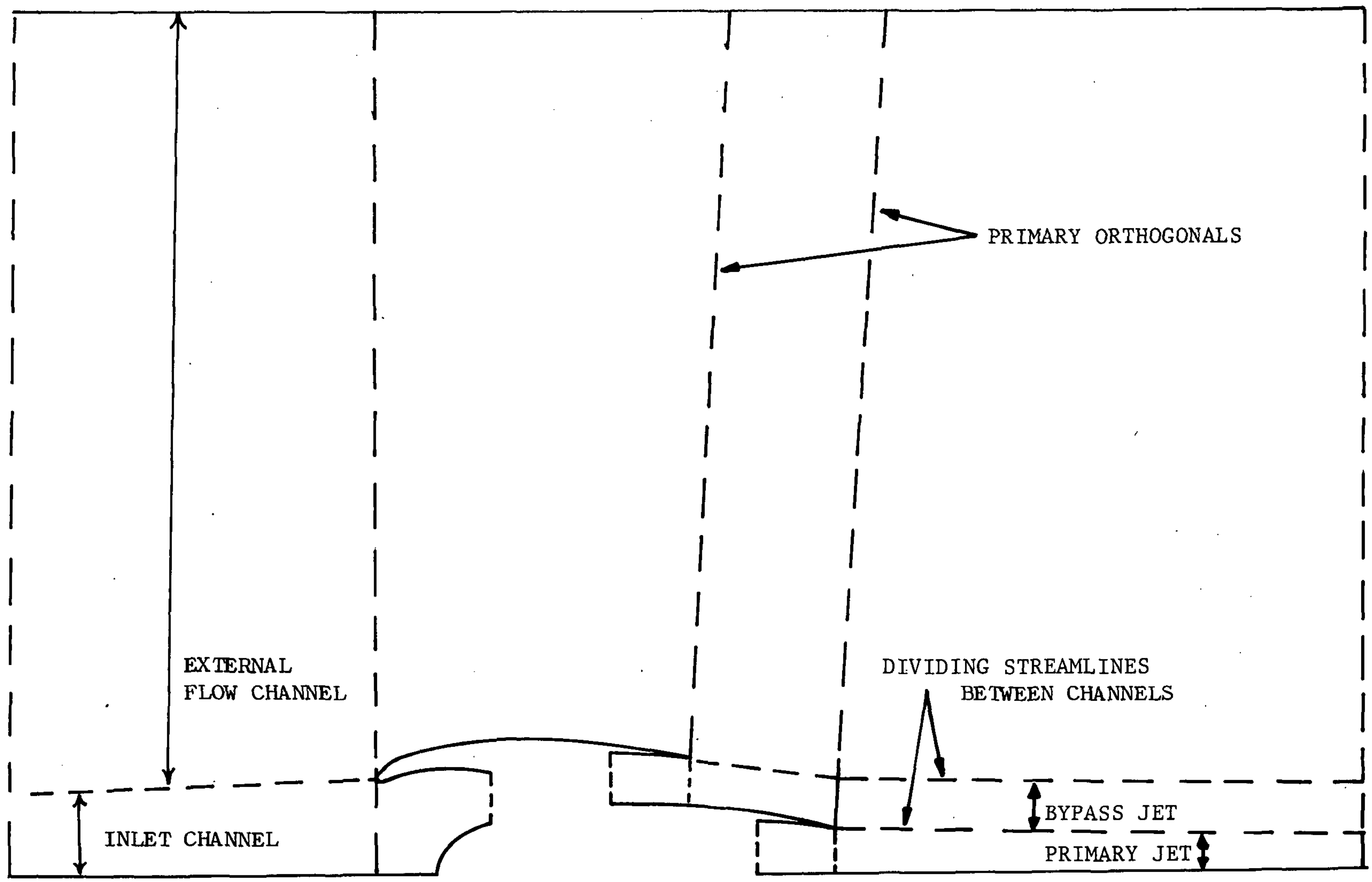
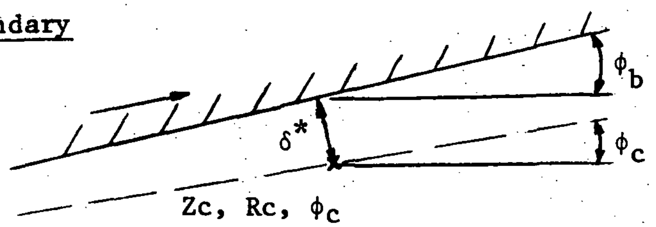


Figure 22. Initial Streamline/Orthogonal Grid Before the First Refinement.

In the fourth step the orthogonality of the grid points is checked and points are moved along the spline curve as required to achieve normal intersections between the two sets of lines. Also, the normal distance, n, is computed for each grid point as measured from the lower boundary of the orthogonal. If boundary layer data are available from a preceeding STC pass, displacement effects are included during the orthogonalization procedure.

Interpolated corrections are applied to the boundaries using the following relations:

Upper Boundary

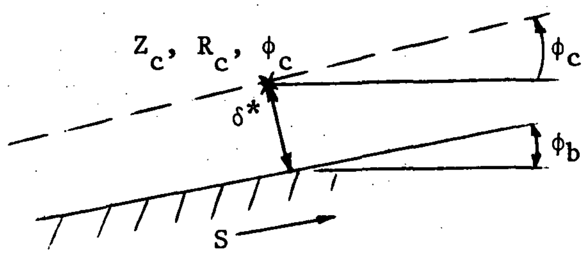


$$\phi_c = \phi_b - \frac{d\delta^*}{ds}$$

$$R_c = R_b - \delta^* \cos(\phi_c)$$

$$Z_c = Z_b + \delta^* \sin(\phi_c)$$

Lower Boundary



$$\phi_c = \phi_b + \frac{d\delta^*}{ds}$$

$$R_c = R_b + \delta^* \cos(\phi_c)$$

$$Z_c = Z_b - \delta^* \sin(\phi_c)$$

If the boundary layer on the solid surface is separated, a comment to this effect is printed each time the boundary is accessed to calculate an orthogonal intersection. When this situation is encountered, the user is advised to discontinue the calculation, since the displacement thickness information downstream of the separation point is in error.

When the initial grid is set up, a boundary is placed some distance away from the body. This boundary becomes the interface between the near-field and far-field solutions. The near-field is computed by the stream-tube curvature method and the far-field is computed by linear small perturbation theory. In the process of iterating, this boundary (which is also a streamline) will float so that its shape and velocity distribution are matched by both the inner and outer solutions. In practice, the shape of the interface streamline (also referred to as the far-field boundary) is first assumed. Using the far-field equations, the velocity distribution is calculated. This is Step 5. These velocities are subsequently employed in the near-field analysis and from this comes a revised shape for the interface streamline. Revised velocities will then be computed in Step 5 during the following iteration cycle, and so forth.

Step 6 is the modification, as required, of the flow rates of the exhaust streams. For boattail analysis of nacelles, the internal geometry of the exhaust passage is required input to the STC program. Because of streamline curvature effects, the discharge coefficient for the nozzle will be somewhat less than unity. The user, however, may input a flow rate based on unity discharge flow coefficient or, for the matter, any approximate value. Determination of the velocity distribution across the throat of the nozzle will be determined within the STC framework and the evaluation of the maximum "choked" flow rate is Step 6 of the calculation procedure.

Step 7 is the solution of the flow field equations per se. This section of the program is referred to as the "flow balance"; Eqs. (16) and (17) are integrated. In the external regions of the field, the momentum equation is integrated from the far-field interface boundary to the body (or to the centerline or lower boundary, whichever exists). The integral form of the momentum equation is:

$$\ell n\ V_o^{\,2} - \ell n\ V_{FF}^{\,2} = 2 \int_{n_o}^{n_{FF}} C\ dn \tag{33}$$

where:

V_{FF} = Velocity as determined in Step 5 along the far-field streamline.

V_o = Velocity at any streamline with orthogonal distance n_o.

n_{FF} = Distance measured along the orthogonal to the far-field streamline.

Although not reflected in Eq. (33), the effect of varying total pressure behind a shock wave is also included. Also, if a slip-line occurs in the field, the velocity jump equations,

$$P_s = P_{T_t}\left(\frac{T_{s_+}}{T_{t_+}}\right)^{\frac{\gamma}{\gamma-1}} = P_{T_-}\left(\frac{T_{s_-}}{T_{t_-}}\right)^{\frac{\gamma}{\gamma-1}} \tag{34a}$$

$$C_{p_+} \; T_{t_+} + \frac{V_+^2}{2} = H_+ \tag{34b}$$

$$C_{p_-} \, T_{t_-} + \frac{V_-^2}{2} = H_- \tag{34c}$$

are employed where the subscripts (+) and (-) denote conditions on the streamlines above and below the slip-line, respectively.

The velocity, total temperature and total pressure allow determination of the density at each grid point, and the inverse product of density and velocity is integrated to find flow area.

$$A_2 - A_1 = \int_{\Psi_1}^{\Psi_2} \frac{\partial\Psi}{\rho V} \tag{35}$$

Step 8 consists of the iterative flow adjustment of the variable flow channels to meet the departure streamline pressure compatibility condition ("Kutta" condition) at all trailing edges. Step 8 is executed only if the streamlines are within tolerance. Also, Step 7 is repeated with each iterative adjustment of the flow rate.

The cumulative flow areas calculated by Eq. 35 are compared with the geometric areas of the streamlines used in Step 3. The difference between these two values is used as a convergence check (Steps 9 and 10) and in the streamline correction equation, Step 11.

In Steps 11 and 12 the proper adjustment of the streamline positions is determined and in Step 13 the grid points are moved in the normal direction by this computed adjustment.

The iterative sequence is to start with a crude grid, as noted above, and to repeat Step 3 and through 13 until the flow balance error is small. This is often accomplished in one or two iterations. Any variable weight flows are then converged. The grid is then refined to the next level and the field is reconverged. The refinement/convergence process is continued until

the grid refinement criteria are satisfied, or alternately, until computer storage limits are reached. At this point, additional loops through Steps 3 to 13 may be performed until the flow balance error is satisfactory.

In Step 14, output quantities are calculated and printed. Boundary layers are also calculated and stored for a subsequent STC restart. Finally, the wake table is adjusted to reflect boundary layer displacement effects at trailing edges.

A complete description of the details of the numerical procedure may be found in References 1 and 3 through 9.

SECTION 6.0

PROGRAM DESCRIPTION

6.1 DATA STORAGE TABLES

The framework of the STC program is designed to allow flexibility as to the configuration to be analyzed. For example, very weak limits are placed on the number of flow boundaries and the number of channels into which the flow is split. And no specific limits are placed on the number of streamlines or the number of orthogonal lines in any given region of the flow. To accomplish this, the bulk of the calculation data is saved in arrays which are singly dimensioned. Within each array the data are packed together to maximize storage efficiency. Descriptions of these tables are provided below.

6.1.1 Field Tables

Flow field data are stored in singly subscripted arrays, one for each variable. The quantities saved at each streamline - orthogonal line grid intersection are as follows:

Z	axial position, abscissa
R	radial or vertical position, ordinate
VM	velocity
PHI1	streamline angle, measured from horizontal
CURV	curvature of the streamline, $-d\phi/ds_1$
S1	curvilinear distance along the streamline
S2	curvilinear distance along the orthogonal line
B	coefficient in matrix equation for DS2, indicator of subsonic (B>0) or supersonic (B<0) velocity
RHS	right hand side of matrix equation for DS2
DS2	correction of streamline positions

In the Fortran coding M is the symbol commonly used as the subscript for the above arrays and NM is the number of field points (or maximum value of M). The points are grouped by orthogonals starting at the upstream orthogonal. Points along the orthogonal are grouped together. Hence, the point below and above the M^{th} point are (M-1) and (M+1) respectively. The neighbors in the streamwise direction, however, are determined by referring to the JMS-table described in Section 6.2.

6.1.2 Channel Input Data Table

Information such as the boundary coordinates and flow properties is compactly stored in a single array, TABLES, so that only the total amount of information saved is limited by the array size. No limit is placed on the amount of information to be placed in any one Table of which there are seven:

- channel input table
- boundary table
- table of convected properties
- table of wake displacment thickness
- boundary layer data table
- flow adjustment table
- station table

In the first table, CHDATA, input information read from page STC/sheet-3 is stored. The information is stored in subtables, one subtable for each channel, and the arrangement of each subtable is as follows:

CHNAM	channel name (BCD)
LHNEXT	length of subtable
WTFLOW	flow rate (if input)
TTO	total temperature
PTO	total pressure
TSO	static temperature
PSO	static pressure
MACHO	Mach number
AO	flow cross-section area
VARY	indicator as to whether the flow rate may be varied
RG	gas constant
GAM	ratio of specific heats
NR	not operational
NC	not operational
TAB	not operational
BB(NR&NC)	not operational, zero length array

Except for the first two words, CHNAM and LHNEXT, all of the above input items are optional and they are all equal to BITS unless values are supplied according to input instructions for STC/Sheet-3. If data for a second channel are supplied, these data will follow the first channel and so forth for any number of channels. The first word of the CHDATA table is at location LHO and the last word is at location LHE relative to the origin of the TABLES-array. If LHE=LHO-1, no channel data has been input and the channel data table has zero length. In the Fortran coding, the subscript LH is used to refer to the channel data.

Channel information is read into the STC program by subroutine RCD; the stored channel data is utilized by routines RTCFI, BCONV, ADJWF, ISBOT, and SABBL.

6.1.3 Boundary Table

Directly following the channel data are the coordinates of the boundaries. Again a subtable for each boundary is constructed and the information is stored in the following order:

BDT	boundary name
LBNEXT	length of subtable
LBZ1	index increment to first coordinate in ZBT, RBT, ANGBT-lists
CHNAME	channel with which the boundary data is associated
UP	upper or lower boundary indicator (if the boundaries around a leading edge have been collated together, then CHNAME(2)=UP is the name of the channel above the leading edge and CHNAME(1) is the name of the channel below the leading edge).
LEDEX	index (relative to ZBT, RBT, ANGBT) of the leading edge point when boundaries are collated
ZBT(1)	axial coordinate (x)
RBT(1)	axial coordinate (y)
ANGBT(1)	surface angle (measured from x-axis in radians)
ZBT(2)	
RBT(2)	
ANGBT(2)	
o	
o	
o	
o	

BDNAME	name of a specific boundary when several boundaries are collated together in one subtable
LBA, LBB	index limits relative to ZBT, RBT, ANGBT of the coordinates for BDNAME

(NOTE - the above 3 items are repeated for each boundary where LBZ1/3 is the number of collated boundaries. The existence of this information results in the displacement of the ZBT, RBT, ANGBT coordinates to higher memory locations. BDNAME, LBA and LBB are equivalenced to ZBT, RBT and ANGBT respectively).

Boundary coordinates are necessary input to the program so two or more subtables will always exist, stacked one after another. The first word of the BDYTAB table is at location LBDO and the last word is at location LBDE. LB is the subscript used to refer to the boundary data.

Boundary coordinates as supplied on page STC/Sheet-2 of the input sheets are read by routine RBD. This routine converts the angles from degrees to radians, translates and rotates the coordinates as required and stores the points so that as one proceeds from one point to the next (or walks along the contour) one's left arm is next to the flow field. Thus, the ordering of points on an upper flow boundary will be reversed and the angles incremented by 180 degrees.

The several boundaries which may be defined to comprise one continuous contour are collated in subroutine BLDTAB. The boundary table is referenced in routines BDYPTM, LBDYBL, and BLTBBL.

6.1.4 Table of Convected Properties

For each channel, a subtable of convected properties and channel flow data is built by subroutine BCONV from data in the channel input table (if it exists) and input data from STC/sheet 1. This table contains some of the same information as the CHDATA table. Information contained in the CONVTB table is complete and follows a consistent format.

CH	channel name
LTNEXT	length of subtable
NPT	not operational (=1)
LPSI	(=15)
LTT	(=16)
LPT	(=17)
LRCU	(=18)
CRG	gas constant
CPGJ	specific heat at constant pressure

C2CP	twice CPGJ
QGAM	inverse of ratio of specific heats, $=1/\gamma$
FGT	$(\gamma-1)/\gamma$
FGP	$\gamma/(\gamma-1)$
FGR	$1/(\gamma-1)$
AREATB	area for calculating flow rate
PSI	flow rate for the channel
TT	stagnation temperature
PT	stagnation pressure
RCU	not operational

Again the data for the several channels are stacked one after another. LTO and LTE are the first and last locations of the table relative to the origin of TABLES. LT is the subscript used to retrieve convected property information of subroutines BLDTBS, RBCONV, ADJWF, TTPT, and SABBL.

6.1.5 Table of Wake Displacement Thickness

The wake displacement table is constructed if there exists a trailing edge, and is arranged as follows:

X2W	streamline coordinate, ξ_2
LWNEXT	length of subtable, = 2N+2
S1W (1)	list of distances from trailing edge
S1W (2)	
:	
S1W (N)	
DST (1)	list of wake displacement thicknesses
DST (2)	
:	
DST (N)	

This table is built in the subroutine BLDTBS by a call to subroutine BWAKE. DST is determined so that the wake thickness equals the trailing edge thickness at S1W=0. Thereafter the wake thickness decrease at the rate of 0.1 times the distance from the trailing edge. At 10 trailing edge thicknesses downstream, the wake thickness is zero.

As many wake thickness subtables are built as there are trailing edges. The wake thickness table begins within the TABLES-array at location LWO and ends at LWE. The table is referenced by the TTPT routine.

At the completion of a boundary layer calculation (if specified), the wake table entries at the trailing edges are adjusted to reflect the trailing edge displacement effects. This procedure is accomplished by subroutine RBWAKE.

6.1.6 Boundary Layer Data Tables

Boundary layer data in the STC-SAB program are stored in the TABLES region immediately before the flow adjustment table. A subtable for each boundary layer is constructed and the information is stored in the following order:

BNAME	Boundary name
LBLNXT	Pointer to the next boundary layer table
NSEP	Index pointing to separation location (normally 0)
DUMMY	
SWREF	Reference distance for alteration of coordinates in the boundary layer table; viz, boundary origin
SIGN	Boundary type -1 Upper boundary +1 Lower boundary
SW(1)	Distance along surface
DSTAR(1)	Smoothed displacement thickness (δ^*)
DDSTAR(1)	Slope of smoothed displacement thickness ($d\delta^*/ds$)
SW(2)	
DSTAR(2)	
DDSTAR(2)	

The boundary layer data table is located between LDO and LDE in the tables region. The index limits LDO and LDO are stored in /IXORIG/after LSE. LD is the subscript used to reference the boundary layer data tables (subroutines BLTBBL and BDYPTM).

6.1.7 Flow Adjustment Table

The flow adjustment table is also created in the BLDTBS routine, one subtable for each trailing edge. The information contained is as follows:

X1F	orthogonal coordinate of the t.e., ξ_1
X2F	streamline coordinate of the t.e., ξ_2
X1BF	ξ_1 coordinate of the choked station of the flow above the t.e. if not X1F

X1AF	ξ_1 coordinate of the choked station of the flow above the t.e. if not X1F
S1F	curvilinear streamline distance to the trailing edge (along the upper surface of the body). This value is used for interpolating the wake displacement thickness.
NCHB	number of channels below the t.e.
NCHA	number of channels above the t.e.
JORDER	= -1 if the single channel flow is choked
	= 1 if channel flow rates below the t.e. are known
	= 2 if channel flow rates above the t.e. are known
VNR (12)	12 element storage array used by subroutine NEWRAP for the flow iteration

The data stored in this table is used by subroutine ADJWF which adjusts the flow so that at each trailing edge the pressure difference from one side of the trailing edge to the other is reduced to zero (to satisfy the Kutta condition). If this condition cannot be satisfied, the flow in one of the channels will be choked and routine ADJWF adjusts the flow to the maximum choked value. The flow adjustment table is located between LFO and LFE. Each subtable is NFCOLS (=20) in length.

6.1.8 Station Table

The station table is the last of the compacted tables and it contains information for each orthogonal line. The table grows during the calculation process because the number of orthogonals is increased to obtain a refined grid. Because it is the last table it can easily be extended into the unused portion of the allotted memory. The data saved for each of the orthogonals is arranged in the station table as follows:

X1	station coordinate, ξ_1
LNEXT	length of subtable
MLB	field point index of first (lower boundary) point of the orthogonal
MUB	field point index of the last (upper boundary) point of the orthogonal
PRIM	primary station indicator, T or F, (a primary station, is one of the original grid stations and it will pass through boundary end points).

TYPELB	type of the lower boundary, i.e. SOLID, FIELD, FARFLD, etc. for indicating proper boundary condition
NAMELB	name of the lower boundary used for referencing the boundary table
ILB	boundary (table) interval of the orthogonal boundary intersection
FLB	fractional position in that interval
S1LB	curvilinear distance from beginning of the interval
TYPEUB	type of the upper boundary
NAMEUB	name of the upper boundary
IUB	interval of the upper boundary
FUB	fractional position in the interval
S1UB	curvilinear distance from the beginning of the interval
VMB	boundary velocity, used as an initial guess for the velocity iteration in the FLOBAL routine
DWDV,SCHOKE	slope of the flow rate versus velocity curve used for the velocity iteration in the FLOBAL routine, = SCHOKE if flow is choked at this station
X2CL	ξ_2 coordinate of the control streamline used for positioning orthogonal lines in the PTMOVE routine
SLSWI	sonic line-shock wave indicator, = 1.0 for mixed flow, = 0. otherwise
MCL	field point index of control streamline, used in PTMOVE only

This group of 20 items is repeated for each station, starting with the upstream and proceeding to the downstream stations. Station table entries at trailing edges contain seven additional items:

ANGTE	Boundary surface angle
PTTE	Total pressure
PSTE	Static pressure
FGRTE	Function of γ, $1/(1-\gamma)$
RGTE	Gas constant
ANGEXP	Flow departure angle just downstream of the trailing edge
BSQEXP	M^2-1 just downstream of trailing edge

Quantities above the trailing edge are stored with the station above the trailing edge and quantities below the trailing edge are stored with the station below the trailing edge. At leading edges, the station table contains 22 entries. The additional items in this case are:

CURVLE	Leading edge curvature
ANGLE	Leading edge angle

Field point calculations are performed by looping through the station table, starting with the first station at L=LO and proceeding to the last station. The last word of the last station is at location LESTA. With exception of the boundary layer table, the above tables are initially constructed with gaps between them. The channel data and boundary tables are constructed simultaneously in the RCD and RDC routines called from REDINP. The maximum size of the channel data region is preset by the value of MAXLH. MAXLH is initialized to 400 but may be input as any value if such should be necessary.

After reading the card data input, at the beginning of the BLDTAB routine, the boundary data is moved down in memory so that it is just above the channel data. The gap between the two tables is thus eliminated.

The remaining four tables are then all built in subroutine BLDTBS. Again spaces between the tables are provided so that they can be constructed simultaneously and grow to the following lengths without interfering with each other:

Table Name	Input Variable Name	Default Value
Convected Properties	MAXLT	200
Wake Displacement Thickness	MAXLW	200
Flow Adjustment	MAXLF	200

At the end of the BLDTBS routine the gaps between the tables are eliminated by moving each table down in memory. The result is that all information contained in these tables is stored compactly, and the last table, the station table, has space into which it may expand. The length of all seven tables combined is limited to the length of the TABLES-array, and this value is adjusted at program load time to meet the size requirements of the flow field.

6.1.9 Streamline Table

The streamline table is not stored in a compact arrangement. It consists of three arrays in a labled common SLTAB.

W	cumulative flow rate for the channel
X2	ξ_2 - coordinate
SLCHN	channel name of which this streamline is a part

The streamline number, J, is the subscript used to access information in each of these three arrays. All of the streamlines for a given channel are together and in order (proceeding away from the centerline). However, no special ordering of channels is required.

6.1.10 Table of Leading Edge and Trailing Edge Points

The Leading Edge-Trailing Edge Point (LETEPT) table is constructed in routine BLDTAB and used in routine BLDTBS for the purpose of defining the flow regions and primary orthogonals. The data in this table is not saved after the BLDTBS routine is executed.

The information in this table is obtained from the boundary table. The ends of boundaries and double points contained within the boundaries are listed, together with the boundary and channel names. Each "line" of the LETEPT table contains the following ten items.

XE	axial coordinate of boundary end point of double point
YE	radial or vertical coordinate
ANGE	mean angle of the flow at XE, YE
NLE	number of times the same point has occurred as an upstream boundary end point. Normally NLE=0 or 1. If NLE=2 then the point is a leading edge.
NTE	number of times point has occurred as a downstream end point. NTE=2 for trailing edge point. NLE=NTE=0 for a double point in the boundary table
CHL	name of flow stream above point
CHU	name of flow stream below point
BDL	name of boundary (UPPER=F)
BDU	name of boundary (UPPER=T)
NUSED	number of times the point has been used in developing the ORTCHN-table, initially = -1 for a double point

After the table is constructed the points (or lines) are sorted so that the upstream points are first and the points follow from upstream to downstream in order. If difficulty is encountered in the development of the basic grid, the information contained in the LETEPT-table may be helpful in diagnosing the error.

6.1.11 Table of Channels Embraced by Each Orthogonal

The LETEPT-table contains all points through which (primary) orthogonal lines are to pass. From this table the ORTCHN-table is developed as an aid to the construction of the initial grid of streamlines and orthogonal lines. The latter table contains a list of all of the channels embraced by each orthogonal. Specifically each "line" of the table contains:

LEDGE	index of the point in the LETEPT-table
LRPREV	previous line number (or ORTCHN-table index) or the upstream orthogonal
CHNA(1)	channel names
CHNA(2)	channel names
CHNA(3)	channel names
CHNA(4)	channel names

The above information is tabulated (one line) for each orthogonal. Also, the first two lines are developed as dummies for the purpose of listing all channels. Other dummy lines may also be inserted. LRD is the index increment between lines and is equal to the total number of channels minus two.

6.1.12 Table of Index Limits

The labeled common /IXØRIG/ contains the index limits for each of the above listed tables. The items and order of storage are as follows:

LHO	location of channel table origin
LHE	location of channel table end
LBDO	location of boundary table origin
LBDE	location of boundary table end
LTO	location of convected properties table origin
LTE	location of convected properties table end
LWO	location of wake displacement thickness table origin
LWE	location of wake displacement thickness table end
LFO	location of flow adjustment table origin
LFE	location of flow adjustment table end
LO	location of the station table origin
LESTA	location of the station table end
LSO	location of the shock point table origin (not used)
LSE	location of the shock point table end (not used)

LDO	location of boundary layer table origin
LDE	location of boundary layer table end
LDUM(4)	unused
MO	unused
NM	number of field points
NJ	number of streamlines
NFCOLS	number of "columns" in the flow adjustment table
MAXNJ	maximum number of strealines (dimensional limits are MAXNJ=128)
MAXOL	maximum number of points on any one orthogonal (dimensional limits are MAXOL=96)
MAXNM	maximum length of field arrays, calculated in subroutine REDINP
MAXLE	maximum table length, calculated in subroutine REDINP
LEO	location of the first word in the LETEPT-table, (=1)
LEE	location of the last word in the LETEPT-table
LRO	location of the first word in the ORTCHN-table
LRE	location of the last word in the ORTCHN-table
LRD	the ORTCHN-table is subdivided into lines and LRD is the length of the lines

6.1.13 Boundary Layer Input Table

The boundary layer input table is stored in labeled common BLBDY. Input boundary layer information as supplied on page STC/Sheet-2 of the input sheets are normally read by routine RBD. The resulting table consists of the following three items stored serially for each boundary:

BLB(I)	Boundary name
BLB(I + 1)	Indicator designator whether a boundary layer calculation is to be performed. 0 - No 1 - Yes
BLB(I + 2)	Initial equivalent flat plate distance to first point on boundary.

The subscript I ranges from 1-58 and is incremented by 3 for each boundary. Information for a maximum of twenty (20) boundary layers may be stored; viz,

Common/BDBDY/BLB(60)

The data input for this table may also be read by subroutine REDINP if the boundary layer is to be initiated by restarting a "non-boundary layer" run.

6.2 ACCESSING DATA IN THE FIELD TABLES

The data stored in the field tables consist of the Z, R, S1, S2, PHI1, CURV, VM, B, RHS, and DS2 at each point in the field. An additional array termed the JMS table provides access to the information in the field tables. This information (subscripted M=1,NM) consists of:

J	Streamline number
MU	M subscript of upstream grid point; MU = 0 at beginning of streamline.
MD	M subscript of downstream grid point; MD = 0 at end of streamline.
ISTAG	Point type indicator ISTAG = 0 - Normal point. 1 - Stagnation (or singularity) point. 2 - Trailing edge point or a point fixed on the body surface used to locate a primary orthogonal. 3 - Point adjacent to a stagnation (singularity) point or an end point of a partial orthogonal.

The word content of each JMS entry is:

		J	MU	MD	ISTAG
GE635 (36 bit word)		8 bits	13 bits	13 bits	2 bits
CDC-6400/6600 (60 bit word)	24 bits unused	8 bits	13 bits	13 bits	2 bits

On the GE-635, the machine word length presents a practical limit to both the number of streamlines (J = 255) and the maximum field size

(NM - 8191). It was felt that these limits represent a convenient maximum for any problem which might be encountered. Hence, the bit configuration for the JMS word on the CDC 6400/6600 is identical to that on the GE635, resulting in an unused portion of 24 bits. The subroutines which pack and unpack the JMS table entries (SAVIX, GETIX, and GETRLX) are coded in the CDC assembly language COMPASS 1.1 in the interest of increased computation speed. These routines would have to be modified if a problem required a streamline number J in excess of 255 or a grid point index M greater than 8191.

6.3 STC CALCULATION STEPS, FLOW CHART, OVERLAY DESCRIPTION

The present section outlines the sequence of calculation steps performed by the STC Program and describes the overlay structure on the CDC 6400/6600 computers.

6.3.1 STC Calculation Steps and Flow Chart

The processing flow chart for the STC program is shown in Figure 23 and includes the principal subroutines, their function, and their associated output. The general calculation steps performed by the STC Program were outlined in Section 5, Method of Solution. Here the calculation steps will be identified with the subroutine performing that step.

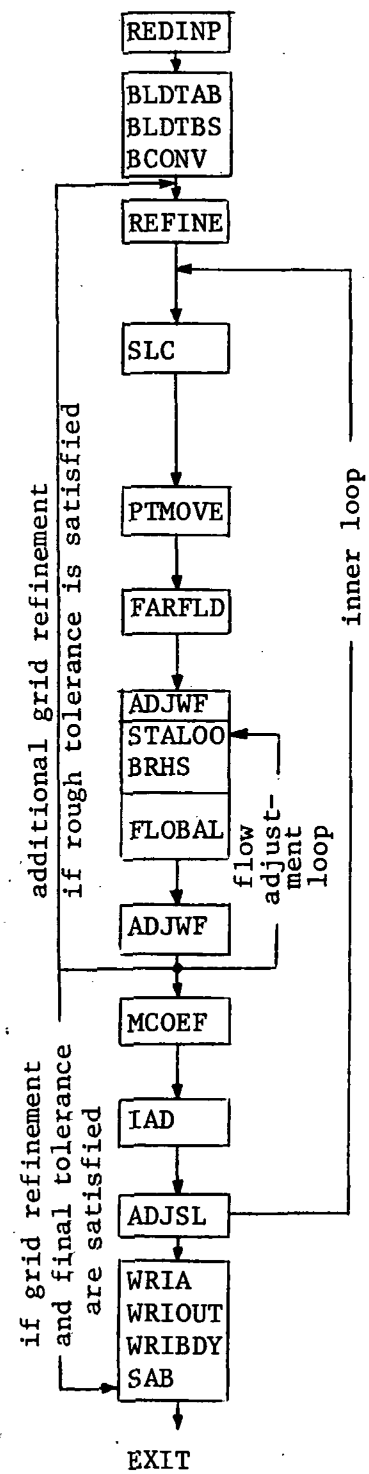
The computer program has been written to analyze many types of geometries and flows. The user must identify the various flow boundaries and channels when the program input is compiled. These sets of flow boundaries (BDY) and channel names (CHN) define flow regions with specified properties of temperature, pressure, and velocity. It is the task of the program user to organize his problem so that each flow region is defined by the proper boundary and channel names (see Figures 21 and 22).

The first operation in the computer program consists of reading the card input for the description of geometry and flow properties in each flow region (REDINP), and then storing and building the various tables (BLDTAB, BLDTBS, BCONV). The channel data, boundary data, and flow property data are each stored in their respective tables. If necessary, the boundary points are smoothed and local angles at each boundary point are calculated.

The field point table and station table are started with the first unrefined grid of orthogonal and dividing streamlines. The boundary of each region is defined as a primary orthogonal. The dividing streamlines which separate the various streams are called double streamlines.

The problem solution is started with the initial "unrefined" coarse grid to prevent crossing grid lines and unrealistic large streamline curvatures. A fully converged inner iteration is carried out to ensure reliability in the later stages of the calculation.

THE STREAMTUBE CURVATURE PROGRAM



Routines	Function	Output
REDINP	Read Input	
BLDTAB, BLDTBS, BCONV	Build Tables and determine first crude calculation net	Z, R, S2, V
REFINE	Refine grid by adding new orthogonals and streamlines as required	Z, R of refined grid
SLC	Calculate streamline curvatures, angles, and distances between points. Locate stagnation points.	S1, CURV, PHI1
PTMOVE	Move points along streamlines to obtain orthogonal lines	Z, R, CURV, PHI1, S1, S2
FARFLD	Calculate velocities on the far field boundary (if present).	UDN
ADJWF	Adjust flow rate at "choked" stations.	
STALOO, BRHS, FLOBAL	Station loop to calculate coefficient B and RHS using "flow balance" equations.	B, RHS, ES2
ADJWF	Adjust flow rates if streamline position is within tolerance	
MCOEF	Calculate matrix coefficients including far field B.C.	A1, A2,........,A8
IAD	Solve matrix equations for streamline movement	DS2
ADJSL	Adjust streamlines.	Z, R
WRIA, WRIOUT, WRIBDY, SAB	Print output Calculate boundary layer Adjust wake displacement tables	δ^*, $\frac{d\delta^*}{ds}$

Figure 23. Program Flow Chart.

The next step in the computational procedure is to refine the very crude initial grid (REFINE). A new orthogonal is placed within each region and a new streamline is inserted in the middle of each channel. In the external channel (identified by CHN EXT), additional streamlines are placed close to the body. After the solution for this grid has been obtained, the intervals are again halved as required.

As the calculation procedure continues, grid refinement is automatically provided in specified flow regions or in regions of high curvature and high acceleration and deceleration. The streamline and orthogonal lines which are added between existing lines are not required to span the field if only local refinement near a boundary is needed. These refinement criteria are discussed in Section 11 and 13.

After refining the grid, the next step (SLC) in the solution is to determine the angles and curvatures of the streamlines at each grid point. For subsonic portions of the flow field, this is performed by fitting a piecewise continuous cubic polynomial (beam) in a coordinate system which is locally rotated for each interval (Figure 24). The locally rotated coordinate system removes the restriction that requires the slope to be small. The matching conditions are the angles and curvatures at each point. At the end of streamlines which terminate at a flow exit boundary or extend to a flow inlet, the end curvature is specified. Normally the end curvature is zero, but the user may input a constant non-zero value of curvature.

For grid points located in a supersonic region, the subroutine SLC employs backward difference formulas in keeping with the switch to the star with no downstream points (Figure 24). Either a 3-point parabola, a 4-point piecewise cubic (beam), or a 5-point formula may be optionally selected. The 3-point parabola is preferred. Again the coordinate system is rotated so that slopes in the curve fitting coordinate system are small. The end conditions for the supersonic curve fit formulas are a specified angle and zero curvature.

An additional task performed by SLC is the location of stagnation points and the definition of the dividing streamline intersection of the boundary at the stagnation point. At leading edges, the dividing streamline is set perpendicular to the boundary surface at the stagnation point, (Figure 25). An orthogonal which goes with the stagnation point is defined and the point on the first streamline is positioned.

In the present version of the STC program, the angle and curvature calculations have been modified to improve the reliability and accuracy in the trailing edge regions. The special conditions enforced by these regions are as follows:

a. Trailing Edge Points, Subsonic Velocity - In the previous version of the program, curvature at the trailing edge point had been taken as the boundary surface values. The curvature at this point is, of course, utilized in the momentum equation integration in the FLOBAL

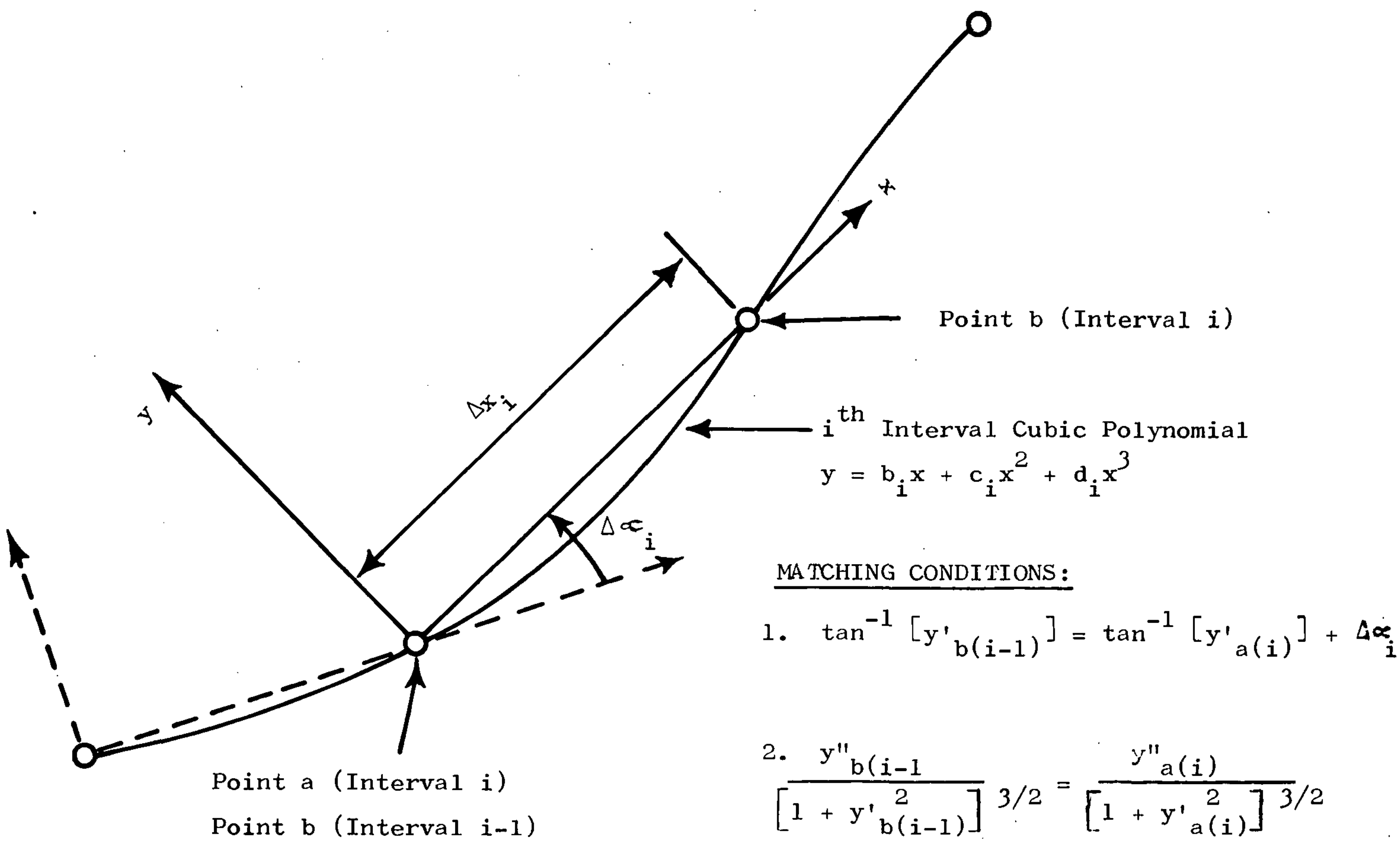


Figure 24. Curve Fit Algorithm.

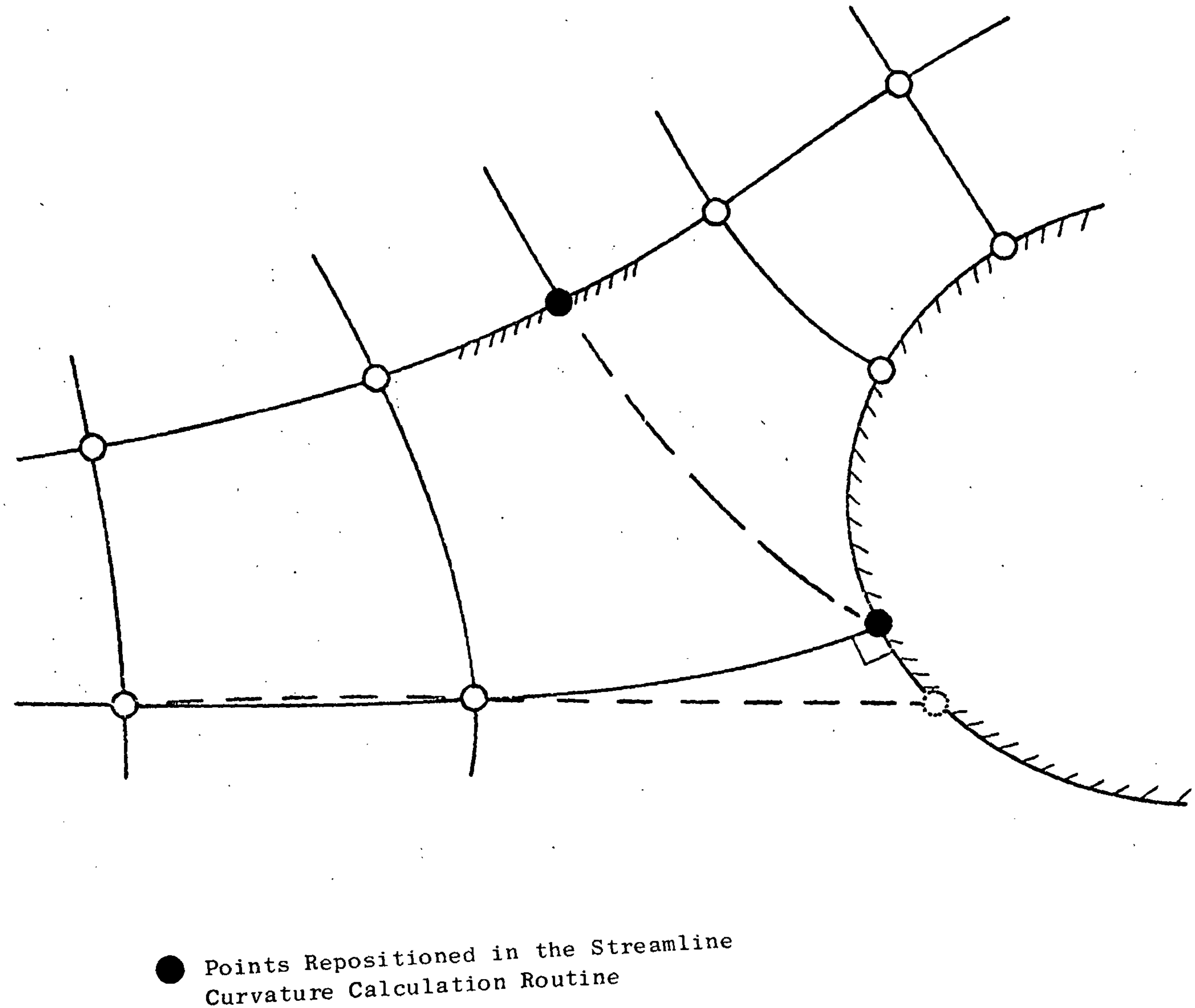


Figure 25. Stagnation Point Iteration.

routine and has a strong effect on the pressure calculated at the trailing edge points. These pressures are utilized in iterating for the flow split above/below the trailing edge and obtaining "pressure closure," and in evaluating the trailing edge flow condition (subsonic or supersonic). A weak singularity really exists at the trailing edge (for a sharp wedge), but is ignored in order to allow integration of the conservation equations across the entire channel and to obtain an approximation of the actual trailing edge pressure.

In the new procedure, the curvature is obtained by fitting a parabola through the trailing edge and the two adjacent streamwise points. This numerical value of curvature is believed to represent a suitable average value for the integration of the momentum equation across the streamtube adjacent to the boundary. Then, in the printout stage of the calculation, the zero velocity, if in fact a singularity does exist, will be enforced.

b. Trailing Edge Point, Supersonic Velocity - If the flow adjacent to the trailing edge is found to be supersonic (during the last flow balance iteration), then the above calculated value is overriden by the boundary curvature as determined by the input boundary description.

c. First Point Downstream of Trailing Edge, Subsonic Velocity - A beam is fit to the points on the dividing streamlines aft of the trailing edge. The end conditions on this beam are now found so that the beam angle bisects the trailing edge if the total pressure on the two sides of the trailing edge are equal. If the total pressure on one side is higher, than the beam angle at the trailing edge is forced to be tangent to that side.

If the trailing edge has bluntness, then the wake length (stored in the Wake Table) is set to $2t/\alpha$ where t is the "total" trailing edge thickness and α is the wedge angle. This allows the two dividing streamlines to be, in effect, circular arcs tangent to each side of the trailing edge and tangent to each other at the wake closing point. Also, beam end conditions are set to the trailing edge boundary angles.

d. First Point Downstream of the Trailing Edge, Supersonic Velocity - The curvature of a supersonic point is calculated by fitting a beam (or parabola) to the last three points along the given streamline. However, in the case of the first point downstream of a trailing edge, a two-point curve fit is now utilized and an angle condition is enforced at the trailing edge point. This angle is found by calculating a Prandtl-Meyer expansion (or compression) to the total pressure of the adjacent stream if the trailing edge is sharp or to the static pressure on the other side of the trailing edge if the trailing edge is blunt. The conditions to which the flow is expanded are saved in the station table (as indicated above) and printed with the other output data for that streamline in WRIBDY. Since the effective wake wedge angle is increased by the corner expansion, a new wake length calculated by the formula above is saved in the Wake Table.

PTMOVE checks the orthogonality of the grid points and moves the points along the spline curve as required to achieve normal intersections, (Figure 26), between the two sets of lines. Boundary layer displacement effects are included at this point. Also, the normal distance, n, is computed for each grid point as measured from the lower boundary of the orthogonal.

When the near-field grid is defined, a boundary is placed some distance away from the body. This boundary becomes the interface between the near-field and far-field solutions. The near-field is computed by the streamtube curvature method and the far-field is computed by linear small perturbation theory, (Figure 27). In the process of iterating, this boundary (which is also a streamline) will float so that its shape and velocity distribution are matched by both the inner and outer solutions. In practice, the shape of the interface streamline (also referred to as the far-field boundary) is first assumed. Using the far-field equations, the velocity distribution is calculated. These velocities computed by FARFLD, are subsequently employed in the near field analysis and from this comes a revised shape for the interface streamline. Revised velocities will then be computed in FARFLD during the following iteration cycle, and so forth. FARFLD is a selected boundary option when the far-field boundary, BDY, is called FF. A solid boundary may also be specified by renaming the far-field boundary and defining the coordinates.

In the next section, subroutine ADJWF is initially called to adjust the flow rate at "choked" stations. For boattail analysis of nacelles, the internal geometry of the exhaust passage is required input to the STC program. Because of streamline curvature effects, the discharge coefficient for a nozzle will be somewhat less than unity. The user, however may input a flow rate based on unity discharge flow coefficients or, for that matter, any approximate value. Determination of the velocity distribution across the throat of a nozzle will be determined within the STC framework. The next three subroutines, STALOO, BRHS, and FLOBAL, develop the solution to the flow field equations represented by continuity, Equation 16, and radial or cross-stream momentum, Equation 17, (Section 5). At each station (STALOO) along a boundary, the flow equations are integrated along an orthogonal (FLOBAL) and the right hand side and the coefficient B ($B = [(1 - M^2)/\rho V^2]$) in Equation 20 are determined (BRHS). In the external regions of the field, the momentum equation is integrated from the far-field interface boundary to the body (or to the centerline or lower boundary, whichever exists). The cumulative streamtube flow areas are then calculated by integrating the continuity equation and compared with the geometric areas of the streamlines defined by SLC. The differences between the streamline position determined by the "flow balance" FLOBAL and by SLC is used as a convergence check. It also defines the right hand side or driving error function in the streamline correction equation, Equation 20.

The next step (ADJWF) is the modification, as required, of the flow rates of the exhaust streams. This step is performed, if the streamline positions are within tolerance, by looping through STALOO, BRHS, FLOBAL, and ADJWF until the trailing edge departure streamline pressure compatability conditions ("Kutta") are satisfied.

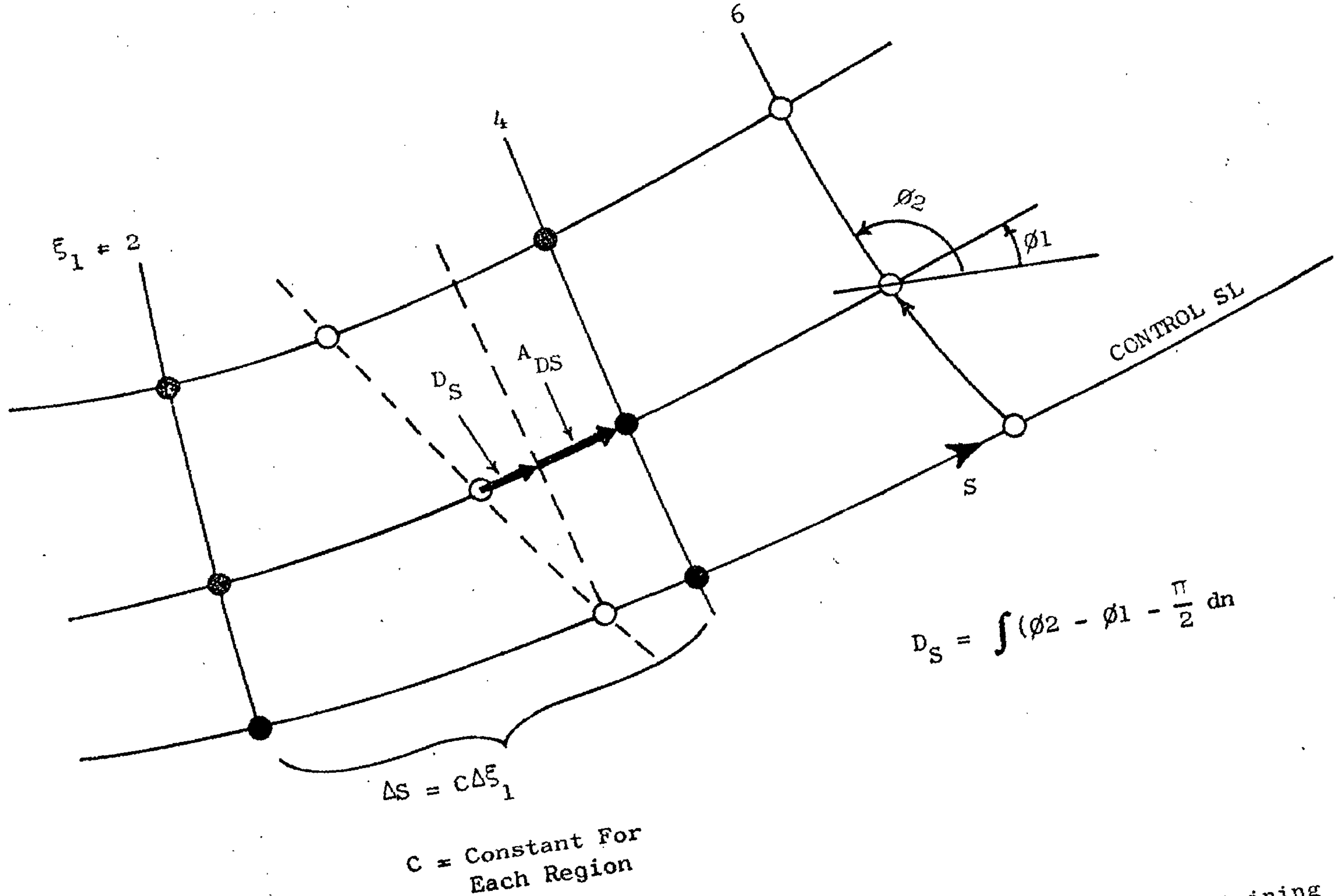


Figure 26. General Positioning of the Orthogonals and Point Movement for Obtaining Lines Normal to the Streamlines.

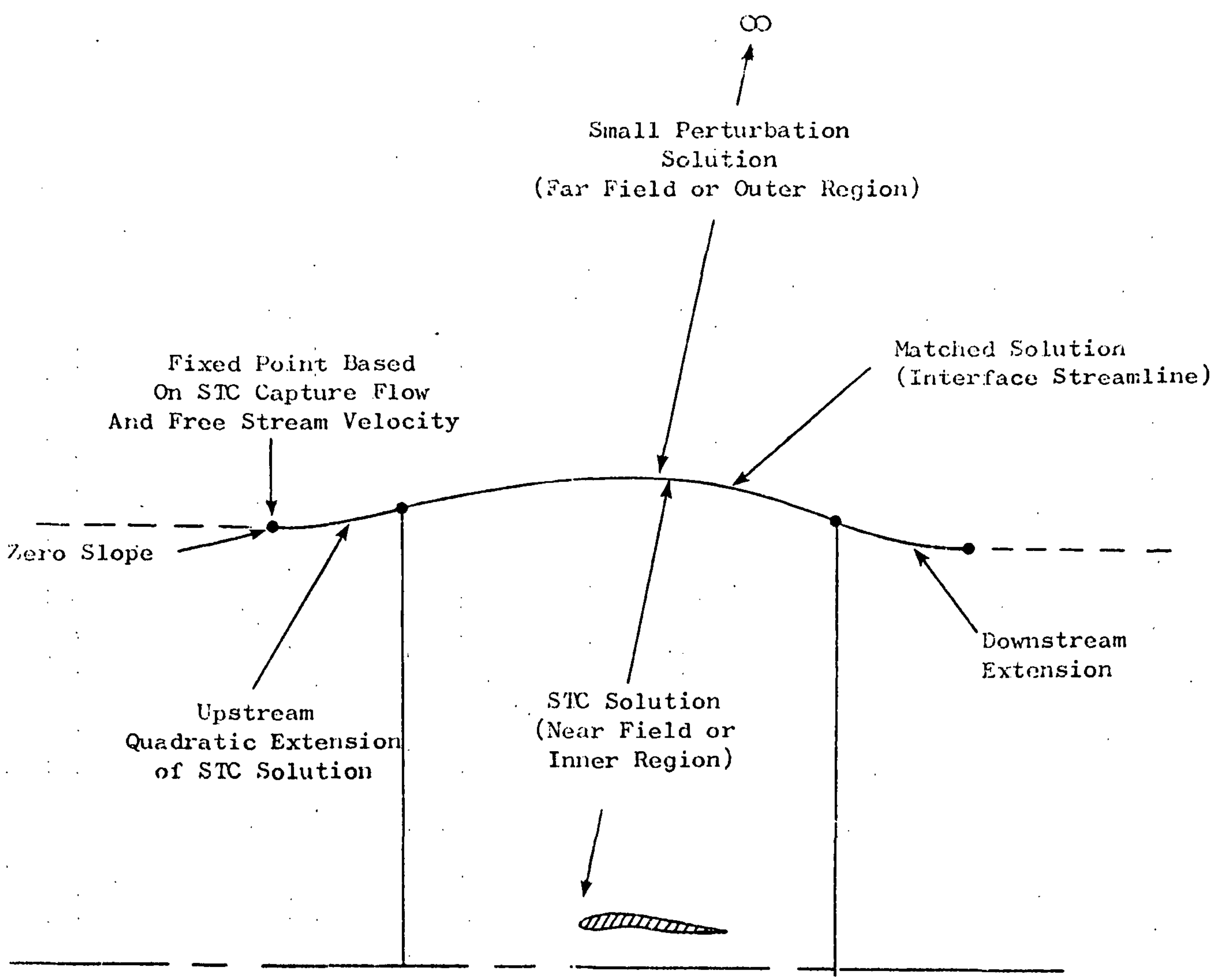


Figure 27. Illustration of Far Field and Near Field Solution Domain.

If the streamline positions are within a convergence tolerance the program logic loops back to REFINE. Additional streamlines and orthogonals are added as required by the refinement criteria. The refinement procedure presently built into the program uses a criteria involving the distance and velocity increment between grid points.

If the streamline convergence tolerance has not been met, the streamline correction equation is solved by defining a matrix, MCOEF, and by solving this matrix using one of several methods. The solution techniques include IAD, Implicit Alternating Direction, or LRELAX, Orthogonal or Streamline Block Relaxation. The user has control of the choice of solution method, but IAD has demonstrated the more stable and faster solutions.

After calculating the streamline correction, δn, the streamlines are adjusted (ADJSL) to their new positions and the program logic loops back to SLC to define new curvatures and geometric streamtube areas. This loop is called an inner solution. Depending on the amount of grid refinement, the inner loop may take from 2 to 20 passes to reach streamline convergence.

As shown above, the iterative sequence is to start with a crude grid and to go through subroutine SLC to ADJSL until the flow balance error is small. The grid is then refined to the next level and the field is reconverged. The refinement/convergence process is continued until the grid refinement criteria is satisfied, or alternately, until computer storage limits are reached. At this point, additional inner loops may be performed until the flow balance error is satisfactory.

Finally, the output quantities are calculated and the results are printed in any of several forms. The output forms are defined in Section 8. During the output sequence, the boundary layer growth on the specificed surfaces are determined. The boundary layer parameters δ^* and $d\delta/ds$ are stored in the boundary layer data tables for use if the STC problem is restarted.

6.3.2 STC Overlay Description

The STC program has been structured for execution on the CDC 6400/6600 machines under the SCOPE 3.1 operating system. The basic OVERLAY features of SCOPE 3.1 have been utilized to reduce the memory requirements to those currently in use at the NASA Langley Research Center. Shown in Figure 28 is the overlay structure including all subroutines and the important data table storage areas. As indicated in this figure, the program consists of a main overlay, four (4) primary overlays, and six (6) subordinate secondary overlays. A brief description of the processing in each overlay is given in the following section. In this description, the word "link" is used interchangeably with the word "overlay".

Overlay (0,0) - Entry STCA

The main overlay (0,0) contains the main program STCA, as well as general purpose subroutines which are called by subprograms in the subsequent primary

0,0

STCA
ATAN3
BARC
BEAM
BEND
BFI
ERRORK
FHEAD
FMPYC
GETIX
GETRLX
JMSPRT
LBDYBL
LBF
LFIT1
LOC2
LSPFIT
LSUM
MBEGIN
MINMAX
MOVE
QIREM
SETM
SS5PT
STAX1
STANO
TABPRT
TAN

/Labeled Commons/

ADJWF1
ALLCOM
BCOMMN
BLBDY
CB
CBEAM2
CBITS
CCURV
CCRX
CDS2
CFRFIN
CFRFLD
CGRAV
CHDATA
CIDEX
CIDEXR
CINNER
CISBOT
CLFIT1
CLINES
CM
CMAXIT
CMAX4
CPHI1
CPI
CPRINT
CPRPRN
CPTMOV
CR
CRHS
CS1
CS2
CSS
CSTALO
CTE
CTHICK
CTOLRL
CVM
CZ
ERASE2
IXORIG
LINMAX
REBL
SLTAB
SLTAB2
SELECT
TROUBL
VISCOS

1,0

STCN
DBSRT1
ERROR1
ISORT
LOOP
LRMDS1
REDBLK

1,1

STCNR
ELLIP
RBD
RBDBLK
RCD
RELOXY
SERS1
SMOINP
SMOO
SMOTH
SMOXEQ

1,2

BUILDT
BLDTAB
BPSORT
FFINIT
FRFDNZ
ISBOT
LFIT2D
MATINV
TTPT

1,3

BUILDS
BCONV
BLDTBS
BWAKE
FILL
JOFCHN
OBI
RBCONV
RTCFI

1,4

PRTPLT

2,0

STCB
CFBBLK
ERROR1
ADJWF2
FLOBAL
LFIT2D
TTPT

2,1

STCX
ADJWF
BRHS
MINMAX
NEWRAP
STALOO

2,2

STCW1
USECDW
BLTBBL
LESTSQ
RBWAKE
SAB
SABBL
SIMEQ
WRIA
WRIBDY
WRIOUT

3,0

STCXX
ERROR1
ADDFPT
ADJSL
ADPTSL
BDYPTM
BF3
BFAC
BFACS
BFAS
FARFLD
INSTA
PTMOVE
REFINE
REFBLK
SLC
SPC
SS5PTC
STTOFI

4,0

STCM
ATDMRS
CUBE
CUBERS
CUBICS
CUFIT
CUFITR
ERROR1
FFINC
IAD
MCOEF
SS5PTI

Figure 28. STC Overlay Structure.

and secondary overlays. The main program STCA provides control for execution of the STC program by loading the appropriate overlays in sequence and testing for completion or convergence of the problem solution.

Also included in the main overlay is the data storage area consisting of the general program tables, the field tables, and the streamline table as discussed in Section 6.1. This storage area represents the largest block of working storage in the main overlay. The sizes of these various regions of memory are initialized by the block data subprogram USECDG. An increase in the number of available field points, stations or streamlines may be effected simply by recompilation of this block data subprogram and the block data USECDM in overlay (4,0).

Overlay (1,0) - Entry STCN

Overlay (1,0) is the primary overlay for the program input and initial construction of the data tables and the unrefined calculation net. Program STCN serves as a driver routine to call in subordinate secondary overlays. These links in turn read the input and build the initial tables and calculation net. Subroutines used concurrently by secondary links also reside in overlay (1,0).

Overlay (1,1) - Entry STCNR

Overlay (1,1) consists of the subroutines to read the card and/or tape input and perform preliminary processing. General input data are read in REDINP and boundary and channel data are read in RBD and RCD respectively. The channel data input table is also constructed in RCD. In the case of the boundary input, if angles are not specified with the coordinates, the SMØTH routines are called to calculate angles by fitting a beam through the specified coordinates. Also, the NACA Series 1 Cowl coordinates are stored internally and may be used to generate an "analytic" contour for a specified boundary segment. The input quantities to select these options are discussed in Section 8.1 and on the input sheets (Section 13.2).

Overlay (1,2) - Entry STCN2

The principal function of overlay (2,1) is to build the boundary table and the leading edge/trailing edge table using the coordinate and angle data from the preceding link. This procedure is accomplished in subroutine BLDTAB. If specified by input, this overlay is recalled to initialize the matrix for the solution on the far field boundary (FRFDNZ).

Overlay (1,3) - Entry STCN3

The bulk of initial table construction is performed in subroutine BLDTBS. Specifically, the orthogonal channel table, the streamline table, the station table, the flow adjustment table, and the wake displacement thickness table

are built in this routine. Subroutine BCONV is called to build the convected properties table as an intermediate task. In the process of table construction, the values of Z, R, S_2, and V for the unrefined grid are placed in the field tables.

Overlay (1,4) - Entry PRTPLT

The principal function of PRTPLT is to provide a printer plot of the input boundaries and the initial "crude" orthogonal - streamline grid. Orthogonals and streamlines are designated by their respective XI1 or XI2 values.

Overlay (2,0) - Entry STCB

Overlay (2,0) is the primary link for calculation of the coefficient B and the RHS of the streamline correction equation using the "flow balance" relations. The subroutine FLOBAL and TTPT are included in this link, since they are used by the output routines to calculate final velocities in the field prior to printing.

Overlay (2,1) - Entry STCS

Overlay (2,1) contains the subroutines STALOO and BRHS to loop through the stations and calculate the coefficients B and RHS for the matrix solution of the streamline adjustment equation. Included also is the subroutine ADJWF which adjusts nozzle flow rates before and after the flow balance calculation.

Overlay (2,2) - Entry STCW1

This overlay is loaded at the end of the problem solution to produce the printed output and generate a restart tape if requested. Subroutine WRIA prints the parameters defined by input, program storage utilization information, solution convergence level as well as generating the restart tape. Subroutines WRIOUT and WRIBDY print out the solution at the field points and the boundaries. If a boundary layer calculation has been specified for a given surface, the boundary layer output follows the normal STC boundary output.

Overlay (3,0) - Entry STCXX

Overlay (3,0) is loaded prior to the execution of the flow balance. The prime functions of this link are to adjust the streamline positions (ADJSL), refine the grid (REFINE), calculate streamline curvatures (SLC), orthogonalize the grid (PTMOVE), and calculate velocities on the far field boundary (FARFLD). The far field routines are only called if these options are in effect. REFINE will not be called if grid refinement limits have been reached, the flow balance error is too large, or the maximum field point limit has been met.

Overlay (4,0) - Entry STCM

Overlay (4,0) contains the subroutines MCΘEF and IAD to set up and solve the matrix equations for the streamline adjustment.

SECTION 7.0

PROGRAM NOMENCLATURE

Communication between the subroutines in each overlay is accomplished by the use of labeled common. With few exceptions, the majority of labeled common storage areas are located in the main overlay. The size and data in these blocks are initialized by the block data subprograms USECDG and STCBLK. The principal labeled common blocks are given alphabetically in the following section. Labeled commons used by general purpose utility subroutines are not included in the tabulation. In most cases, the use of these commons is given in the listing of the pertinent subroutine (Volume II).

Within each block, variables are listed according to the position occupied in the block. In some cases, the variable name may differ between routines and a typical name is given. Also, several areas are used primarily as erasable temporary storage and are denoted as such in the description of the labeled common. Inspection of the source listing should indicate the particular use of these areas by a given subroutine. The pertinent dimension and type information are included with the variable name (R ≡ Real, I ≡ Integer, L ≡ Logical). Variables normally containing BCD data are typed as H ≡ Hollerith, even though they may have real or integer names.

Block Name	Typical Variable Names	Type	Dimensions	Description
ADAM01				Identification Block
	NAME	H	6	User name
	ADDRES	H	6	User address
	DUM	-	6	-----------
	IDENT	H	6	Problem identification
ADJWF1				Communication for flow adjustment procedure
	MODE	I	1	Weight flow adjustment operating mode (see listing of subroutine ADJWF)
	LFF	I	1	Flow adjustment table (T.E.) index
	MODEO	I	1	MODE initialization value
	LFO	I	1	LFF initialization value
ALLCOM				Contains reference Mach number, pressures, temperatures, gas properties
	MACHA	R	1	Reference Mach number (free stream)
	PSA	R	1	Reference static pressure
	TSA	R	1	Reference static temperature
	PTA	R	1	Reference total pressure
	TTA	R	1	Reference total temperature
	AXIA	L	1	Problem type; (T) axisymmetric, (F) plane
	RGA	R	1	Gas constant
	GAMA	R	1	Isentropic exponent
	DUM	-	10	
	TTE	R	1	Body closure tolerance
	CHOTST	L	1	Input indicator to perform (T) or omit (F) choke test when adjusting flow

Block Name	Typical Variable Names	Type	Dimensions	Description
BCOLLT				Collated boundary location (used by SAB boundary layer routine)
	ZBCOL	R	1	Z location of boundary collation
BCOMMN				Program control common
	PROGM	H	1	Program name STC
	TAPIN	L	1	Input tape indicator (T)
	TAPOT	L	1	Output tape indicator (T)
	DUM	-	6	
	FILIN	L	1	Internal equivalents of TAPIN, TAPOT
	FILOT	L	1	
BLSEP				Boundary Layer Separation index
	NSLOC	I	1	Index of separation point in boundary layer SW Table (normally 0)
BLDTA				Boundary Layer Communication
	BDNAME	I	1	Boundary name
	LOWER	L	1	T = Lower boundary F = Upper boundary
	IBTYPE	I	1	Initial condition indicator 1 = Boundary layer initiated at stagnation point 2 = Axisymmetric spinner 3 = Boundary layer initiated at a mid-boundary stagnation point
	N1	I	1	Index of first point in boundary layer SW table
	NI	I	1	Index of last point in boundary layer SW table
	CAPX1	R	1	Equivalent flat plate distance from boundary layer origin to first calculated boundary layer point.

Block Name	Typical Variable Names	Type	Dimensions	Description
BLDTA1				Boundary Layer Communication
	BNAMSV	I	1	Current boundary name passed to the boundary layer routines by WRIBDY.
CA2	A2	R	300	Curvature Influence Coefficient (MCOEF)
CA3	A3	R	300	Curvature Influence Coefficient (MCOEF)
CA4	A4	R	300	Influence Coefficient related to flow difference between streamlines (MCOEF)
CA5	A5	R	300	Curvature Influence Coefficient (MCOEF)
CA6	A6	R	300	Curvature Influence Coefficient (MCOEF)
CA7	A7	R	300	Influence Coefficient related to flow difference between streamlines (MCOEF)
CA8	A8	R	300	Influence Coefficient related to flow difference between streamlines (MCOEF)
CB	B	R	300	Coefficient B of Matrix Equation at field points
CBITS				General Common for junk words
	BITS	R	1	BITS = 1.E + 15
	BLANK	H	1	BLANK = 1H
CBDYPT				Angle and curvature of adjusted boundary point (PTMOVE)
	ANGD	R	1	Angle at adjusted boundary point
	CURVD	R	1	Curvature at adjusted boundary point
CCRX				Control common for insertion of orthogonals and streamlines during grid refinement
	CRXSL	R	1	New streamline extension
	CRXOL	R	1	New orthogonal lines across a subsonic region
	CRXSS	R	1	New orthogonal lines across a supersonic or mixedregion

Block Name	Typical Variable Names	Type	Dimensions	Description
	CRXE	R	1	New orthogonal lines which cross a sonic line
	CRXC	R	1	New orthogonal lines which cross a supersonic to subsonic compression line
CCURV	CURV	R	300	Curvature at field points
CDS2	DS2	R	300	Streamline adjustment at field points
CFB				Flow Balance Communication Block
	L	I	1	Current station index
	MA	I	1	Lower boundary field point index
	MB	I	1	Upper boundary field point index
	WF	R	1	Flow rate if different from value in the streamline table
	PLB	R	1	Desired pressure on lower boundary (if known), otherwise = 0
	PUB	R	1	Desired pressure on upper boundary (if known), otherwise = 0
	CHOKE	L	1	= T for calculation of maximum (choked) flow
	SUBSON	L	1	= T for subsonic branch, = F for supersonic branch
	NK	I	1	Number of streamlines at given station (L)
	PLBC	R	1	Calculated lower boundary pressure
	PUBC	R	1	Calculated upper boundary pressure
	XCHOKE	R	1	BCD word SCHOKE
	TAREA	R	1	Total passage area for all streamtubes
	VMBC	R	1	Calculated velocity on upper boundary
	WRQST	R	1	Requested flow (from SLTAB)
	WCALC	R	1	Calculated flow
	QV	R	8	Flow balance iteration history vector
	QVP	R	8	Pressure balance iteration history vector

Block Name	Typical Variable Names	Type	Dimensions	Description
	JSUM	I	1	Indicator used for detecting a change in the channel
	VMLBSQ	R	1	Velocity squared on lower boundary
CFFFIN				Far-field initialization
	ATINF	R	1	Free stream stagnation speed of sound
	MINF	R	1	Free stream Mach number
	RFFREF	R	1	Reference (R,Y) location of far-field
	UINF	R	1	Free stream velocity
	ZDN1	R	1	Upstream limit of far-field
	ZDN25	R	1	Downstream limit of far-field
CFFFLD				Far-field solution - communication
	NFF	I	1	Number of STC points on far-field boundary
	MAXFF	I	1	Maximum Number of STC points on far-field boundary
	ZFF	R	64	Streamwise coordinates of STC points on far-field boundary
	RFF	R	64	Transverse coordinates of STC points on far-field boundary
	ZDN	R	25	Streamwise coordinates for far-field solution
	DRDN	R	25	Interpolated far-field flow angles at ZDN
	UDN	R	25	Calculated velocity on far-field boundary @ ZDN
	ZIJ	R	25,25	Zij matrix for far-field solution
CGRAV				
	CG	R	1	CG = 32.174 ft - $lbm/lb_f\ sec^2$
CHDATA				CHDATA contains the STC tables described in Section 5.1
CIADIN				Control Common for matrix solution
	RHOBAS	R	1	Base acceleration factor, ρ_B

Block Name	Typical Variable Names	Type	Dimension	Description
	RHOAMP	R	1	Half amplitude of the acceleration factor, ρ_A
	IADM	I	1	Sweep parameter, = 0 for IAD = 1 for orthogonal block relaxation = -1 for streamline block relaxation
CIDEX				Communication common used by GETIX and SAVIX to store and retrieve data from JMS array
	M	I	1	Current field point index
	J	I	1	Streamline number
	MU	I	1	Field index of upstream point
	MD	I	1	Field index of downstream point
	ISTAG			Point type indicator 0 - Normal point 1 - Stagnation point 2 - Primary orthogonal 3 - Partial orthogonal termination
CIDEXR				Communication used by GETRLX to retrieve data from the JMS array
	M	I	1	Current field index
	DUM	-	4	
	M3	I	1	Field index of point upstream of M (ISTAG = 3 points skipped)
	DUM	-	4	
	M5	I	1	Field index of point downstream of M (ISTAG = 3 points skipped)
	DUM	-	4	
	M2	I	1	Field index of point upstream of M3 (ISTAG = 3 points skipped)
	DUM	-	4	
	M6	I	1	Field index of point downstream of M5 (ISTAG = 3 points skipped)
	DUM	-	4	

Block Name	Typical Variable Names	Type	Dimension	Description
CINNER				*Control Common for inner iterations*
	INRCTR	I	1	Counter for inner iterations (set to 0 when grid is refined)
	DUM	-	1	
	NINNER	I	16	Number of inner iterations at a given refinement level. Inner iterations continue until INRCTR = NINNER(MAJCTR) or ES2MX $\leq$ ES2LIM
	CNVF	R	16	Fractional percentage of total point movement to be used at a given refinement level (0. < CNVF(MAJCTR) $\leq$ 1.)
CISBOT				Common for special boundary types
	FARFLD	H	2	Boundary names specified as farfield boundaries (FF,FF)
	FREE	H	2	Boundary names specified as free streamlines (FREE1,FREE2)
	PRES	H	2	Boundary names where pressure is specified (PRES1,PRES2)
	DUM	-	1	
	NZP	I	1	Number of entries in ZP, PPS tables
	ZP	R	10	Table of Z(X) values for interpolation of pressure on boundaries where pressure is specified
	PPS	R	(10)	Table of pressures PPS (ZP)
	DUM	-	2	
	ADUM	R	6	Additional storage for special boundary information ADUM(1) = fractional extension of farfield in streamwise direction; ADUM(2-6) not used
CLFIT1				LFIT Communication (BDYPTM)
	LFOUT	L	1	F - If interpolation is out of range, set interpolated value to first or last value in table T - If interpolation is out of range, set interpolated value to 0.

Block Name	Typical Variable Names	Type	Dimension	Description
CM	JMS	I	1	Table of packed words containing pointers to field tables
CMAXIT				Control common for grid refinement levels
	MAXIT	I	1	Maximum number of grid refinement
	MAJCTR	I	1	Current refinement level
	GREFIN	L	1	Indicator set by subroutine REFINE to indicate that a grid refinement has occurred (T)
	DUM	-	1	
CMAX4				Location and value of maximum flow balance error
	ES2MX	R	1	Maximum streamline position error as determined byflow balance
	ZMX	R	1	Z coordinate of ES2MX
	RMX	R	1	R coordinate of ES2MX
	DS2MX	R	1	Maximum streamline movement
CPHI1	PHI1	R	300	Flow angle field points (radians)
CPI				Table of constants
	PI	R	1	PI = π = 3.14159265
	TWOPI	R	1	2 * PI
	PIQ2	R	1	PI/2
	PIQ4	R	1	PI/4
	TODEG	R	1	TODEG = 57.2957795 deg/radian
	TORAD	R	1	TORAD = 0.0174532925 radians/deg
CPRINT				Diagnostic print and control array

Block Name	Typical Variable Names	Type	Dimension	Description
	PDD	R	6	Variables in this common will be described in Section VII A. - Program Input
	PDUM	R	20	
CPRPRN				Print control for field (WRIOUT)
	PRPRN	I	1	PRPRN =-1 Field printout at each station deleted
CR	R	R	300	Transverse coordinate (R,Y) at field points
CREFIN				Grid refinement control
	DUM	-	2	
	VMG1	R	1	Maximum Mach number increment between grid points in streamwise direction
	VMG2	R	1	Maximum Mach number increment between grid points in normal direction
	NGR	I	1	Number of entries in GR, SGR tables
	NGZ	I	1	Number of entries in GZ, SGZ tables
	GR	R	10	Grid radius
	SGR	R	10	Grid size in radial direction
	GZ	R	10	Streamwise grid distance
	SGZ	R	10	Grid size in axial direction
CRHS	RHS	R	300	Right hand side of matrix equation at field points
CS1	S1	R	300	Cumulative distance along streamline at field points
CS2	S2	R	300	Cumulative distance along orthogonal line at field points

Block Name	Typical Variable Names	Type	Dimension	Description
CSS				Supersonic Calculation Control
	SSFML	I	1	Supersonic curvature formula number
	SSEF	L	1	Supersonic entering flow, T or F
	SSEANG	R	1	Entering flow angle for SSEF = T (Degrees)
	SSDF	L	1	Supersonic discharge flow (T or F)
	SSFEND	R	1	Supersonic beam downstream and condition
	SSFND1	R	1	Supersonic beam upstream end condition
	SSDLE	L	1	Supersonic flow below and aft of a leading edge point (T or F)
	A4FACT	R	1	Control point influence coefficient factor
	RHOW	R	1	Flow difference damping factor
	RHOWSS	R	1	Supersonic-flow difference damping factor
	TSIC	R	1	Number of points to be used for transonic interpolation of curvature
	RHOC	R	1	Curvature damping factor
	RHOCSS	R	1	Supersonic-curvature damping factor
CSTALO				Transonic field point count
	NSSPTS	I	1	Number of imbedded supersonic points
CTE				T.E. flow adjustment parameters
	TOLWF	R	1	Tolerance on weight flow
	TOLWFU	R	1	Tolerance on weight flow for satisfaction of the Kutta condition at a trailing edge
	TEXI2	R	1	T.E. XI2 coordinate
	TWF	R	1	Flow rate of variable channel
	TERWF	R	1	Kutta condition indicated fractional flow error

Block Name	Typical Variable Names	Type	Dimension	Description
	JRET	I	1	Branch indicator used by subroutine ADJWF
CTOLRL				Solution tolerance, sweep control
	TOLRL	R	1	Tolerance on matrix solution relative to maximum streamline movement
	MAXSWP	I	1	Sweep limit for relaxation solution of matrix equation
	CLEN	R	1	Characteristic grid size
	DVM	R	1	
	TOLES2	R	1	Relative tolerance on point movement predicted by flow balance
	NSWP	I	1	Number of sweeps required for convergence of matrix solution
	DS1	R	1	Damping factor on point movement along streamlines
	DS1MXA	R	1	Maximum point movement along streamlines
	DS1MXB	R	1	Maximum calculated point movement along streamlines before damping
	DS1RMS	R	1	RMS value of the calculated point movements along streamlines
	DVM	R	1	
	DS1RMO	R	1	RMS value of the calculated point movements along streamlines after grid refinement
	SG1MIN	R	1	Minimum grid size as determined by REFINE
	TOLINR	R	1	Inner iteration tolerance on streamline movement
CVM	VM	R	300	Velocity at field points
CZ	Z	R	300	Streamwise coordinate at field points
ERASE			800	
ERASE2			1536	Temporary storage areas
ERASE3			2036	

Block Name	Typical Variable Names	Type	Dimension	Description
IXORIG				Table of Index Limits
	LHO	I	1	Lower index limit for channel input table (CHDATA)
	LHE	I	1	Upper index limit for channel input table (CHDATA)
	LBDO	I	1	Lower index limit for boundary table (CHDATA)
	LBDE	I	1	Upper index limit for boundary table (CHDATA)
	LTO	I	1	Lower index limit for convected property table (CHDATA)
	LTE	I	1	Upper index limit for convected property table (CHDATA)
	LWO	I	1	Lower index limit for wake table (CHDATA)
	LWE	I	1	Upper index limit for wake table (CHDATA)
	LFO	I	1	Lower index limit for flow adjustment table (CHDATA)
	LFE	I	1	Upper index limit for flow adjustment table (CHDATA)
	LO	I	1	Lower index limit for station table (CHDATA)
	LESTA	I	1	Upper index limit for station table (CHDATA)
	LSO	I	1	Lower index limit for shock table (CHDATA)
	LSE	I	1	Upper index limit for shock table (CHDATA)
	LDO	I	1	Lower index limit for boundary layer data table (CHDATA)
	LDE	I	1	Upper index limit for boundary layer data table (CHDATA)
	LDUM	I	4	Dummy - future growth
	MO	I	1	Initial point in field tables
	NM	I	1	Number of field points
	NJ	I	1	Number of streamlines
	NFCOLS	I	1	
	MAXNJ	I	1	Maximum number of streamlines
	MAXOL	I	1	Maximum number of orthogonals
	MAXNM	I	1	Maximum number of field points

Block Name	Typical Variable Names	Type	Dimension	Description
	MAXLE	I	1	Maximum number of leading edge/trailing edge points
	LEO	I	1	Lower index limit for leading edge/trailing edge table
	LEE	I	1	Upper index limit for leading edge/trailing edge table
	LRO	I	1	Lower index limit for orthogonal/channel table
	LRE	I	1	Upper index limit for orthogonal/channel table
	LRD	I	1	Number of channels +1
LETEPT				Table of leading edge/trailing edge points
	XE	R	1	Streamwise coordinate
	YE	R	1	Transverse coordinate
	ANGE	R	1	Angle
	NE	I	1	Number of leading edge coincident points
	NTE	I	1	Number of trailing edge coincident points
	CHL	H	1	Channel name below point
	CHU	H	1	Channel name above point
	BDL	H	1	Lower boundary name associated with point
	BDU	H	1	Upper boundary name associated with point
	NUSED	-	491	Additional tables having the preceding format
MOMFLX				Storage for momentum flux calculation (channel) (WRIOUT)
	STXU	R	128	Entering channel axial momentum flux
	STXD	R	128	Leaving channel axial momentum flux
	STYU	R	128	Entering chanel normal momentum flux
	STYD	R	128	Leaving channel normal momentum flux
SELECT				Communication common between main overlay and primary overlays

Block Name	Typical Variable Names	Type	Dimension	Description
	LENTRY	I	1	Select key for different entries
SLTAB				Streamline table
	W	R	128	Flow rate
	X2	R	128	ξ_2 coordinate
	SLCHN	H	128	Channel name
SLTAB2				
	PTR	R	128	Total pressure ratio

SECTION 8.0

STC PROGRAM INPUT/OUTPUT

The following sections are concerned with the input to the STC program, special user instructions, and the output produced by the STC program. The standard system files INPUT and OUTPUT (TAPE6 = OUTPUT) are used for card input and printed output respectively. Additional data files designated as TAPE1 (input) and TAPE2 (output) may be used by the programs. In general, these files will reside on magnetic tape.

The standard option exercised in the STC program is to use pressure and temperatures in dimensionless form normalized by the free stream ambient pressure and temperature. When the SAB boundary layer is chosen, however, pressures and temperatures must be given in dimensional form. Representative sets of units for input and output parameters are given in Table I.

8.1 PROGRAM INPUT

Input sheets for the STC program are given in Section 13.0, along with special notes pertinent to the use of these sheets. Optional program input, not normally required, will be described in this section. Input data may be in the form of punched cards or a magnetic tape file (output file from a previous execution of the STC program). Data read from a magnetic tape file may be selectively over-ridden or augmented by input cards. Four (4) distinct card input sets are read by the program and are:

1.	Input sheet 0	Identification information
2.	Input sheet 1	Overall input data
3.	Input sheet 2	Boundary coordinates
4.	Input sheet 3	Channel flow properties

The first input set, consisting of identification information, is read once in a given run using fixed field format (6A10). The remaining input sets consist of a header card followed by a NAMELIST input list $A. Standard FORTRAN IV NAMELIST (Volume II) is used to read these latter lists. Successive cases may be run using only input sets 2 and 4. In all cases, the channel flow properties (input set 4) may or may not be present.

The input parameters for each set are given in the following section. Included in these descriptions are the input items appearing on the input sheets as well as controls for special program options and the modification of preset tolerances.

Table I. Consistent Units for STC Programs.

Parameter	Dimensionless (STC)	Units			
		Eng. Grav. (in.)	Eng. Grav. (ft.)	CGS	MKS
Length	any	in.	ft.	cm	m
Pressure	*atm	psia	psfa	dynes/cm^2	N/m^2
Temperature	*atm	°R	°R	°K	°K
Dynamic Viscosity	-	lbm/in. sec.	lbm/ft. sec.	g/cm. sec.	Kg/m. sec.
Gas Constant	1	ft^2/sec.^{2} °R	ft^2/sec.^{2} °R	ergs/°K-gm	J/°K-kg
Gravitational Conversion Constant	-	ft-lbm/lbf sec.^{2}	ft-lbm/lbf sec.^{2}	(unity)	(unity)
Velocity	**	ft/sec.	ft/sec.	cm/sec.	m/sec.

* m - Normalized by ambient conditions

** - Dimensionless (values are approximately equal to a Mach number difference)

8.1.1 Identification Information Input Sheet 0

The first three (3) cards of the input deck consist of the name and address of the user and the problem identification.

Card No.	Cols.	
1	2-61	User name (1-60 alphanumeric characters)
2	2-61	User address or location (1-60 alphanumeric characters)
3	2-61	Problem identification (1-60 alphanumeric characters)

Blank cards may be substituted for input quantities not required.

8.1.2 Overall Input Data Input Sheet 1

The first card of this input set is a header card consisting of a 1 in column 2, the word STC starting in column 4, and a T or an F in both columns 14 and 24.

Card Column	Description
2	1 - Denotes overall data input
4-6	STC - Denotes program name
14	Input tape? (T or F)
24	Output tape? (T or F)

The header card is followed by the NAMELIST $A and the associated overall input data. The NAMELIST input is terminated with a $ in column 2.

Input Parameters for General Usage

Parameter	Description	Preset Value
MACHO	Mach number	
TSO	Ambient temperature	1.0
PSO	Ambient pressure	1.0
RG	Gas constant	1.0
GAM	Ratio of specific heats	1.4
RHL	Highlight radius	1.0
RM	Maximum body radius	1.0
TTE	Body closure tolerance	0.

Parameter	Description	Preset Value
AXI	Problem type T = Axisymmetric F = Planar (2-D)	T
GR(1)	Table of transverse coordinates for grid refinement tables (up to 10 values)	
SGR(1)	Table of transverse grid refinement criteria (up to 10 values)	1.
NGR	Number of entries in the GR, SGR tables	1
GZ(1)	Table of axial coordinates for grid refinement tables (up to 10 values)	
SGZ(1)	Table of axial grid refinement criteria (up to 10 values)	
NGZ	Number of entries in the GZ, SGZ tables	0
VMG1	Maximum Mach number increment between grid points in streamwise direction	0.1
VMG2	Maximum Mach number increment between grid points in normal direction	0.1
MAXIT	Maximum number of grid refinements	
RHOC	Curvature damping factor	1.0
NODENS	Number of grid refinements for which the streamline positions are found by using a constant density (Based on total temperature and total pressure)	0
*TREF	Reference temperature for viscosity calculation	518.688° R
*MUREF	Reference viscosity at TREF	10^{-6} lbm/in sec
*SCON	Sutherland Constant	198.6° K

*Used for SAB boundary layer calculation only

Optional Input

The following input quantities are considered optional input in that they are not normally required for execution of the STC program. These items consist, in general, of input controls for special program options and input data to modify preset or initialized constants and parameters.

Stagnation Properties, Optional

Parameter	Description	Preset Value
PTO	Stagnation pressure	1.0
TTO	Stagnation temperature	1.0

The total pressure and total temperature may be input by specifying PTO and TTO normalized by the free stream static temperature and pressure. Alternately, the total conditions are calculated from the Mach number, MACHO, and the ambient pressure and temperature, PSO and TSO.

Special Controls for Supersonic Flow, Optional

Parameter	Description	Preset Value
SSFML	Formula number of calculation of supersonic curvatures = 1 for 3 point parabola = 2 for 4 point piecewise cubic (i.e. beam) = -1 for 3 point parabolas for both subsonic and supersonic points	1
SSEF	Supersonic entering flow along the upstream boundaries? T or F	F
SSEANG	Entering flow angle for SSEF = T (degrees)	0.
SSDF	Supersonic flow downstream of a choked station? T or F	F
SSFEND	Supersonic beam downstream end condition (SSFML = 2) 0. = Parabola 1. = Cubic	.75
SSFND1	Supersonic beam upstream end condition (SSFML = 2) 0. = Parabola 1. = Cubic	.75
TSIC	Number of points to be used for transonic interpolation of curvature	2.
RHOW	Flow difference damping factor	1.
RHOWSS	Supersonic - flow difference damping factor	1.
RHOCSS	Supersonic - curvature damping factor	1.

Boundary Conditions for Streamline End Points, Optional

Parameter	Description	Preset Value
NBCIN(1)	NBCIN(1) ≡ Upstream, NBCIN(2) ≡ Downstream NBCIN = 1 Angle Specified NBCIN - 2 Curvature specified	2
ACF(1)	ACF(1) ≡ Upstream, ACF(2) ≡ Downstream; Angle or curvature	0.

Matrix Solution Controls, Optional

Parameter	Description	Preset Value
IADM	Sweep parameter 0 = IAD 1 = Orthogonal block relaxation -1 = Streamline block relaxation	0
RHOBAS	Base acceleration factor parameter, ρ_B	0.5
RHOAMP	Half amplitude of the acceleration factor, ρ_A Note: $\rho = \rho_B + 2\rho_A \sin^2 \left[\frac{n\pi}{2\sqrt{NM}}\right]$	0.5
MAXSWP	Maximum number of sweeps	200
TOLRL	Relative tolerance for matrix solution; $\lvert \Delta DS2 \rvert \leq TOLRL*DS2_{max}$.	.001

Flow Balance Solution and Flow Adjustment Controls, Optional

Parameter	Description	Preset Value
TOLES2	Relative tolerance on maximum point movement predicted by the flow balance	0.001
TOLINR	Inner iteration tolerance on streamline movement	0.05
NINNER(1)	Number of inner iterations (without grid refinement). Specify up to MAXIT values	16*10

Parameter	Description	Preset Value
CNVF(1)	Fractional percentage of total point movement to be used at a given refinement level. Specify up to MAXIT values	10*1.0
TOLWF	Tolerance on the fractional flow adjustment needed to meet the trailing edge pressure closure condition	0.001

Grid Refinement Parameters, Optional

The following input items may be used to control the length of orthogonal lines and streamlines as the grid is refined. the use of these parameters is discussed in the following section on "special user instructions".

Parameter	Description	Preset Value
CRXSL	Used for extending new streamlines	.375
CRXOL	Used for extending new orthogonal lines across a subsonic region	.375
CRXSS	Used for extending new orthogonal lines across a supersonic or mixed region	.125
CRXE	Used for extending new orthogonal lines which cross an expanding flow sonic line	0
CRXC	Used for extending new orthogonal lines which cross a supersonic to subsonic compression line	0

Optional Print and Control Options

Optional diagnostic print and special logic controls are located in common /CPRINT/. Normally these variables are set to 0.. As indicated in the following section, the print controls will provide output from a number of routines. The setting, pertinent subroutine, and resulting printout are indicated. Several variables control logic flow only.

Parameter	Description
PRTES2, PDD(1)	Subroutine BRHS =2 Print B,RHS,DS2,Z,R,PHI,CURV, and ES2 for the two stations with maximum ES2. (DS2 is the value computed during the previous iteration.) >2 Print the above information for PDUM(8) $\leq \xi_1 \leq$ PRTES2. (B,RHS and DS2 are the values computed during the previous iteration.)

PDD(3)

Subroutine IAD

≠0 Print matrix solution for DS2 at end of each sweep. This indicator is turned on internally if $NSWP > MAXSWP - \sqrt{NM} - 2$

PDD(6)

Subroutine BRHS

=2 Suppress area scaling for ES2 calculation

PDUM(1)

Subroutine SLC

>1 Print ZB,RB,ANGD,CURVD during iteration for stagnation point location

=1 Print results of curvature calculation

=2 Print results of supersonic curvature calculation

=4 Print curvature results if point is a stagnation point or the termination of a partial orthogonal

PDUM(2)

Subroutine SLC (Sharp T.E. Logic)

=0 Treat T.E. singularity by numerical approximation. Average angle and curvature are obtained by a 3-point curve-fit and these values are printed in the tabulated WRIBDY output. Supercritical flow on the other side of the T.E. will be expanded to the computed (static) pressure, like the blunt T.E. case

(=1) Use the same logic except that a Prandtl Meyer fan, if one exists, is expanded only to the total pressure. On the concave corner side, the actual flow angles and stagnation pressure are printed in WRIBDY instead of the numerically computed values.

PDUM(3)

Subroutine SLC (Wake decay rate)

=0 Set wake angle to physical wedge angle minus Prandtl Meyer expansion angle. $0 < PDUM(3) < 1$ is a damping factor; viz, 0 = no damping.

=1 Use physical wedge angle.

PDUM(4) Subroutine SLC (curvature formula downstream of T.E.)

=0 Use the "End Internal Parabola" (FEND = 0) for end condition on the trailing streamline. Also, use 3-point backward curvature formula for 1-st point downstream of T.E., if M > 1.

(=1) Use T.E. angle plus Prandtl Meyer expansion as an end condition for a 2-point curvature formula if M>1.

=2 Use downstream T.E. singularity angle for the beam curvature formula (M<1).
(Set PDUM(2)=1 for compatible printout)

PDUM(5) Subroutine MCOEF

=1 Print influence coefficients, G, relating streamline point movement to the negative of curvature

=3 Print above information for partial orthogonal points only

=4,5 Print above information for 1st and 2nd points upstream of leading edge

=4,5 Set FEND(2)=0 for leading edge stagnation point (FEND(2)=1 standard)

PDUM(6) Subroutine ADJWF

>0 Print results of flow adjustment iteration

PDUM(8-9) Subroutine FLOBAL

Print flow balance related data if
PDUM(8) $\leq \xi_1 \leq$ PDUM(9) and
PDUM(8)*PDUM(9) $\neq$ 0

PDUM(10) Subroutine BUILDT

=1 for printout of tables described in Section 4.1 after they are first constructed

=2 for printout of all tables at end of solution

PDUM(11) Subroutine FARFLD

$\neq$0 Print coordinates, slope, velocity on the far field boundary

Parameter	Description
PDUM(12)	Subroutine MCOFF ≠0 Use spline influence coefficients even if SSFML = -1
PDUM(13)	Subroutine FARFLD =0 Use "linear" interpolation on the far field boundary ≠0 Use "least squares parabolic" interpolation on the far field boundary
PDUM(17)	Subroutine BDYPTM =0 Print separated boundary layer message ≠0 Delete print of separated boundary layer message
PDUM(18)	Subroutine FLOBAL =1 for calculation of normal shock total pressure loss for transonic compressions
PDUM(20)	Subroutine FRFDNZ ≠0 Print matrices used in far field solution
PDUM(19)	Subroutine SLC =2 Omit stagnation point iteration on first time through SLC
PRPRN	Subroutine WRIOUT ≠-1 Print field information at each station

Arbitrary Pressure and "Free" Boundary Input, Optional

Parameter	Description	Preset Value
NZP	Number of entries in tables of ZP vs PPS for pressure and free boundaries. NZP $\leq$ 10.	
NZP1	Number of entries which apply to first boundary if two are present	
ZP(1)	Table of axial distance	
PPS(1)	Table of pressures	
PSPIV	=0 PPS entries are pressures =1 PPS entries are velocities	0

The special boundary names which trigger the pressure boundary use are described in a following section. When two boundaries are used, entries for the second boundary follow the entries for the first boundary. When a section of the flow field is bounded by two pressure or free boundaries, the end boundary angle must be specified.

ACF(2) = ______, NBCIN(2) = 1,

Blockage/Lamina Thickness Input, Optional

Parameter	Description	Preset Value
NTHKX	Number of entries in the THKX table $2 \leq$ NTHKX ≤ 25 (axial)	
THKX	X or Z axial coordinate	
NTHKY	Number of entries in the THKY table $1 \leq$ NTHKY ≤ 25 (vertical)	
THKY	Y or R vertical coordinate	
THIK2D(J,I)	Fraction of unblocked circumference or lamina thickness THIK2D ≤ 250	

In the THIK2D table, the vertical variations must be listed first; viz,

[THIK2D (J,I), J = 1, NTHKY], I = 1, NTHKX

The THIK2D table is not extrapolated. Outside the range of THKX or THKY, the end values in the THIK2D table will be used.

Boundary Layer/STC Restart Cases

Parameter	Description	Preset Value
INPBLR	Numbers of input boundaries for which a boundary layer calculation is to be performed	0

When INPBLR is input, INPBLR fixed format cards must follow the $A.....$ overall input data namelist set. The information on these cards consists of the following items:

Card Column	Description
2-7	Boundary name, 1-6 alphanumeric characters
12-21	Equivalent flat plate distance from boundary layer origin to the first calculated boundary layer point (F10.6 format)

The second input item may also be specified as CAPX1 input list (see next section). The boundary data list may be read only once; hence, it is normally necessary to specify a boundary layer calculation at the beginning of the problem. In many cases, it is desirable to obtain a fully converged STC solution before introducing boundary layers into the calculation. The above input allows the introduction of boundary layers at any stage of the solution by using a restart procedure and following the restart $A Namelist with the fixed format boundary layer input.

8.1.3 Boundary Coordinates — Input Sheet 2

The first card of this input set is a header card containing a 2 in column 2, the word BDY, starting in column 4, the boundary name in column 14, and the channel name in column 24.

Three special boundary options are provided: far-field, pressure, and free. The far-field option may be used for an external flow upper boundary and may be invoked by naming the boundary FF. This name causes the numerical flow solution to be matched to a small perturbation analytical solution in the region from the "far-field" boundary to infinity.

An arbitrary static pressure may be specified along one or two boundaries by using the boundary names PRES1 and/or PRES2. The boundary pressure specification is described in Section 8.1.2.

A free boundary is a constant pressure boundary which is downstream of a fixed boundary and has the same pressure level as the pressure at the last point on the fixed boundary. The special names for this type of boundary are FREE1 and FREE2. Further information on this type of boundary is given in the input sheet notes (Section 13).

Card Column	Description
2	2 - Denotes boundary input
4	BDY - Denotes input type
14	Boundary name, 1-6 alphanumeric characters
24	Channel name, 1-6 Alphanumeric characters

The header card is followed by the NAMELIST $A and the associated input for the specified boundary. The NAMELIST is terminated with a $ in column 2.

Parameter	Description	
UPPER	Boundary position	
	UPPER = T	Upper boundary
	UPPER = F	Lower Boundary
ZRONLY	Geometry indicator	
	ZRONLY = T	No surface angle input
	ZRONLY = F	Surface angle input

Two options are available for the input of the boundary geometry. Either the coordinates and the surface angle (measured from the positive x-axis) may be input, or the coordinates alone may be input. In either case the points must be input accurately. The first option (ZRONLY = F) is preferred. With the second option (ZRONLY = T), a beam is fit to the input points to determine the angles and, in the process, the beam fit angles and curvatures are printed. To determine whether a suitably smooth curve has been fitted to the points, the user should examine the curvatures and make sure they are reasonable. In general, the points should not be closely spaced except as required in regions of high curvature. In these regions, the angle change between points should be less than 25 degrees.

The NACA Series 1 cowl coordinates are stored internally, and may be selected by specifying ZRONLY = T and B(1) = 991, 1, followed by the high-light coordinates and the coordinates of the maximum diameter. If the cowl is to be extended beyond the end of the Series 1 contour, the "maximum diameter" coordinate is repeated and then other coordinates are listed.

Boundary coordinates are normally input in tabular form using the B block as specified on input sheet 2. All points must be listed in the stream-wise direction for each boundary. Points at sharp corners must be listed twice, once for each angle which exists at the point. Normally, pressure and Mach number distributions will be printed at each orthogonal intersection with the boundary. Orthogonals may be forced to coincide with boundary points by listing the point twice in the input and setting DBLPTS = 0. (see optional boundary input).

The column names in the B array are Z (or X), R (or Y), and ANGD.

Parameter	Description
B(1)	Input block for boundary data
	column 1 Z or X coordinate
	column 2 R or Y coordinate
	column 3 Angle or slope of surface

If desired, the data in the B array may be input in "free form" using the symbolic names associated with the appropriate columns of the B block.

Parameter	Description
R	Normal (radial) coordinate (axisymmetric)
Y	Normal (vertical) coordinate (Planar)
Z	Axial coordinate (asixymmetric)
X	Axial coordinate (planar)
ANGD	Angle or slope of surface

Boundary data input via the B block will override corresponding data input in the "free form".

Boundary Layer Specification

The preset program option is to not calculate a boundary layer on a given surface.

The necessary input to specify a boundary layer calculation is as follows:

Parameter	Description	Preset Value
BL	F - No boundary layer T - Boundary layer	F
CAPX1	Equivalent flat plate distance from boundary layer origin to the first calculated boundary layer point.	

Optional Input

Optional input parameters, not shown on input sheet 2, are available to apply linear transformations to the input coordinates. Also, input control may be specified to force orthogonals to be placed at selected boundary input points. This is accomplished by repeating the coordinates in the boundary input and specifying DBLPTS = 0. Normally, DBLPTS = .01 forces removal of extra orthogonal stations where the angle discontinuity is less than .01 degrees.

Parameter	Description	Preset Value
DBLPTS	Double point tolerance. Double points will be deleted if the angle discontinuity is < DBLPTS (degrees)	0.01
ROTATE	Angular rotation in degrees	
ZPIVOT RPIVOT	Coordinates of the pivot point of rotation	
SCALE	Multiplicative constant to be applied to the coordinate data	
ZTRANS	Translation increment in axial direction	
RTRANS	Translation increment in radial/vertical direction	

8.1.4 Channel Flow Properties — Input Sheet 3

The first card of this input set is a header card containing a 3 in column 2, the word CHN starting in column 4, and the channel name starting in column 14.

Card Column	Description
3	3 - Denotes channel input
4	CHN - Denotes input type
14	Channel name, 1-6 alphanumeric characters

Channel flow properties are specified in the following NAMELIST A, which is terminated with a $.

Parameter	Description	Preset Value
GAM	Ratio of specific heats	1.4
RG	Gas constant	1.0
TTO	Total temperature normalized by free stream static temperature	
PTO	Total pressure normalized by free stream static pressure	
MACHO	Mach number	
TSO	Static temperature normalized by free stream static temperature	1.0
PSO	Static pressure normalized by free stream static pressure	1.0

Specify either TTO and PTO (if known) or MACHO, TSO, and PSO if the Mach number is known. When these options are not used, the second option is employed with the free stream values of PTO and TTO computed from the MACHO supplied in the overall input data (sheet-1).

Parameter	Description	Preset Value
AO	Nondimensional flow area normalized by the product of π and the square of the highlight dimension. For plane cases input $\Delta Y_o/\Delta Y_{HL}$. For inlets AO $\approx$ mass flow ratio.	

The flow is computed using the total properties as determined from the supplied Mach number, MACHO, and the flow area AO. If input data are not supplied for a given channel, the reference properties on input sheet-1 will be employed with the area calculated at the entrance station.

Individual sets of boundary and channel data need not be input in any particular order. For example, boundary input for the upper and lower surfaces bounding a given channel (input sheet 2) may be followed by the input

for the pertinent channel (input sheet 3). While arbitrary placement of these input sets may be used, it is well to develop some standardized conventions for the sequential input of boundaries and channels. This will be discussed further in the following section on special user instructions.

8.2 PROGRAM OUTPUT

The output from the STC program may be logically divided into the following eight sections.

1. Card input and preliminary printout
2. Input and calculated boundary coordinates and angles
3. Printer plot of initial XI1, XI2 grid.
4. Solution history
5. General input and output data
6. Flow field data along orthogonal lines
7. Calculated flow data along field boundaries and final channel momentum balances.
8. Boundary layer data

The above sections appear sequentially in the output except when PRPRN = -1. In this case, the print of the flow field data along orthogonal lines is eliminated and the calculated boundary information and boundary layer output follow the general input/output section.

8.2.1 Card Input and Preliminary Printout

The initial section of output consists of a card image print of the problem input and a designation of the tape input/output file selections; viz, TAPIN = T/F and TAPOT = T/F. Upon completion of the card image print, the file TAPE5 is rewound to its original position.

8.2.2 Input & Calculated Boundary Coordinates & Angles

Boundary coordinates are processed and printed as they are read. The columnar output displayed for each boundary consists of the input coordinates (X,Z), (Y,R) and the input or calculated body slope (ANGD) in degrees. Preceding these items is a bold heading specifying BOUNDARY COORDINATES, the boundary name (BDY = name), the adjacent channel (CHN = name), whether the surface is an upper (UPPER = T) or a lower (UPPER = F) boundary, and boundary layer specification (BL = T,F). When the ZRONLY = T option is in effect, intermediate printout will be produced defining the results of the beam curve fit to the input coordinates. Since no smoothing is applied to these coordinates, the only meaningful output is the (X,Z) (Y,R) and the calculated angles (ANGD). Break points in boundaries (double points) enable the curve

fit of a boundary in segments. The consolidated output, consisting of the collated boundary data for all segments, follows the above intermediate printout. The NACA Series 1 cowl coordinates (ZRONLY = T) appear as 40 points in a form similar to that described previously.

Normally, a plot of the XI1, XI2 initial grid (described in Section 8.2.3) is printed as the next section of output. When far-field boundary conditions are applied, however, a comment is inserted on the output designating the original transverse location and streamwise extent of the far field boundary. Prior to calculation, the upstream and downstream limits of the far field streamline are extended to insure that the velocities are well behaved at the streamwise ends of the STC integration region. The coordinates of the resulting far field boundary are printed below the above comment.

8.2.3 Printer Plot of Initial XI1, XI2 Grid

The STC program uses an auxiliary numbering system (ξ_1,ξ_2) for orthogonal lines and streamlines. The coordinate ξ_1 = X1 and ξ_2 = XI2 apply to the orthogonal lines and streamlines respectively. A printer plot of the initial XI1, XI2 grid, along with the nominal boundary shape appears as the next section of output.

8.2.4 Solution History

The solution history output provides a convenient summary of the problem history as the solution proceeds through major grid refinements and inner iterative improvements of the flow balance. Included in this section are the parameters defining the grid refinement, the inner iterations, the matrix solution, the flow balance error, and the flow adjustment parameters for the "Kutta" iteration at trailing edge points. The pertinent variables in their literal order of appearance in the solution history list are:

Variable	Description
NREFIN	Grid refinement level
GRID PTS	Number of field points
INRCTR	Inner (flow balance) iteration level
NSSPTS	Number of imbedded supersonic points
NSWEEPS	Number of iterative sweeps for solution of the matrix equations. = 0 when INRCTR = 0.
MAX-DS2	Maximum streamline correction predicted by the matrix solution for DS2. = *0.000000 when INRCTR = 0.
MAX-ES2	Maximum ES2 predicted by flow balance
LIM-ES2	Limiting streamline ES2 for satisfactory solution of the flow balance.

Variable	Description
*Trailing Edge-XI2	XI2 coordinate at trailing edge
*Flow Rate	Variable channel flow rate
*Fractional Flow Error	Fraction flow error during flow adjustment iteration for satisfaction of the "Kutta" condition

* This output is blank if there are no trailing edges

8.2.5 General Input and Output Data

The output in this section consists of general input and a summary of selected output parameters. All of these items have been defined previously in Sections 8.1 and 7.0, hence only the general subdivisions of this printout will be listed.

a. General Input — Section 8.1

b. Streamline End Conditions — Section 7.0

c. Supersonic Curvature Parameters — Section 7.0

d. Subsonic/Supersonic Branch Selection — Section 7.0

e. Grid Size Criteria — Section 8.1

f. Memory Utilization

The memory usage in terms of field points, STC table storage, and number of streamlines is compared with the maximum available values of these parameters.

g. Convergence Data — Section 8.1

h. Special Boundary Options

i. Matrix Solution — Section 7.0

j. Contents of Channel Input Table — Section 7.0

k. Channel Flow Rates, Pressures and Temperatures

Included in this output are the channel flow rates and the pressures and temperatures in each individual channel. Note that the flow rate in a given channel may be adjusted to satisfy the Kutta condition at a trailing edge. When dimensional properties are input, the columns denoted PT/PSO and TT/TSO have units compatible with the dimensions of the input gas constant RG.

8.2.6 Flow Field Data Along Orthogonal Lines

Flow field data on orthogonal lines are printed when PRPRN ≠ -1. The first portion of output on each page consists of the program name (STREAMTUBE CURVATURE PROGRAM) and the problem identification. Following the problem identification is a heading with the constant station value ξ_1 = XI1 along with the channels through which the given orthogonal passes. Primary (initial) orthogonals are flagged with ** after ξ_1. At the extreme right of this line of output is the flow type; viz., SUB = subsonic, SUP - supersonic, or CHOKE = choked. Pertinent data from the field arrays are printed in column format. Stagnation points do not appear in the flow field output.

Variable	Description
X12	Streamline numbering coordinate ξ_2
STRM FNCT	Dimensionless stream function; fraction of flow in channel
X, Z	Streamwise coordinate
Y,R	Transverse or cross stream coordinate
PHI	Flow angle, deg.
CURV	Streamline curvature
PS/PO	Ratio of local static pressure to reference static pressure
PS/PT	Local static to total pressure ratio
TS/TT	Local static to total temperature ratio
CP	Pressure coefficient

$\dfrac{P_s - P_\infty}{\frac{1}{2}\gamma P_\infty M_\infty^2}$	Compressible
$\dfrac{P_s - P_\infty}{P_\infty M_\infty^2}$	Constant density ($\gamma = 0$)
0	MACHA $\leq$ .1

MACH	Mach number
AREA	Flow area
PTQPTO	Channel total pressure ratio

For primary orthogonals, the axial and normal momentum fluxes are printed following the field data. These items are:

$$\text{Axial Momentum Flux} = \int V \cos \phi \, dw + \int (P-P_s) \cos \phi \, dA$$

$$\text{Normal Momentum Flux} = \int V \sin \phi \, dw + \int (P-P_s) \sin \phi \, dA$$

8.2.7 Calculated Flow Data Along Field Boundaries-Final Channel Momentum Balances

The final section of standard STC output includes the flow parameters on the upper and lower streamlines bounding each channel. Normally the boundary data follows the field data. In the case of PRPRN = -1, however, the boundary information is printed immediately after the general input/output section.

Three lines of identification information head the boundary data, and consist of the program title (STREAMTUBE CURVATURE PROGRAM), the specific case identification, and a designation as to whether the boundary is an upper or lower portion of the given channel. The streamline coordinate (XI2) is given following the channel name. Boundary flow parameters are printed at orthogonal intersection and consist of the following items:

Variable	Description
XI1	Orthogonal (station) numbering coordinate (ξ_1)
S1W	Distance along boundary
XW, ZW	Axial coordinate
YW, RW	Vertical or radial coordinate
ANGW	Flow angle or surface angle
CURVW	Streamline or surface curvature
PS/PO	Local static to reference pressure ratio
CP	Pressure coefficient

$$C_P = 2(P-P_s)/\gamma P_s M_o^2$$

$$C_P = Rg(P-P_s)/P_s M_o^2 \qquad (\gamma = 0, \text{ constant density})$$

$$C_P = 0 \qquad (M_o < .1)$$

Variable	Description
PS/PT	Local static to total pressure ratio
MACH	Local Mach number
PT/PO	Ratio of local total to reference static pressure

The cumulative drag/thrust is printed in the column labeled CDPI. The force is normalized by the free stream dynamic pressure (q) and the maximum area based on RM and is given by:

$$CDPI = \frac{(P-P_{ref})\ dA}{q\ A_{max}}$$

The adjacent column (A-AMAX)/AMAX is the projected area normalized by the maximum area. Following the column printout is the ratio of boundary total temperature to ambient total temperature. When the boundary is the approach stagnation streamline, the inlet additive drag is printed below the total temperature ratio. This force is also normalized by q and AMAX and is printed for both the upper and lower stagnation streamline.

Momentum Balance

The STC program evaluates the thrust/drag on each boundary surface bounding a given channel and then verifies these forces by performing an "overall" momentum balance for each of the fluid streams. The integral momentum balance output follows the boundary output for a given channel. This information consists of the entering axial momentum, the integrated pressure forces on the boundaries, and the leaving axial momentum. The discrepancy between the leaving momentum and the sum of the inlet momentum and the pressure-area forces represents the net error in the calculation. This error may be attributed to inaccuracies in the computed pressure distributions or, perhaps, to insufficient refinement of the calculation grid for adequate resolution.

8.2.8 Boundary Layer Data

The standard output from the SAB portion of STC consists of the boundary layer parameters at each orthogonal intersection of the boundary. The initial output consists of a bold heading specifying BOUNDARY LAYER. This is followed by the boundary layer parameters.

Variable	Description
XW	Axial coordinate
THETA	Momentum thickness
	$$\theta = \int_o^{\delta} \frac{\rho V}{\rho_e V_e} \left[1 - \frac{V}{Ve}\right] dm$$
DSTAR	Displacement thickness
	$$\delta^* = \int_o^{\delta} \left[1 - \frac{\rho V}{\rho_e V_e}\right] dm$$
DELTA	Boundary layer thickness δ
REX	Local Reynolds Number $R_{e_x} = \frac{\rho_e V_e s}{M_e}$
CAPX	Equivalent flat plate distance along surface
	$$X = \frac{1}{Pr^a} \int_{S_1}^{S} Pr^a ds$$
	where $P = \left[\frac{M}{1 + .2M^2}\right]^4$
	a = 0 Planar flow a = 1 Axisymmetric flow
CF	Skin friction coefficient
	$$C_f = \frac{\tau_w}{1/2\ \rho_e V_e^2}$$
	τ_w = Shear stress at solid surface
SW	Distance along surface
DSTR	"Smoothed" displacement thickness δ^*

Variable	Description
DDSTR	Derivative of DSTR ($d\delta^*/ds$) used for correcting the local flow angle
SEP	Separation flag. Normally blank, appears as SEP if the boundary layer has separated
F	Stratford separation parameter

The Stratford separation parameter is defined as follows:

$$F = \bar{C}_p \left[s \frac{d\bar{C}_p}{ds} \right]^{1/2} \left[10^{-6} \; Re_x \right]^{-0.1} \qquad \bar{C}_p = 1 - \frac{M^2}{M_1^{\,2}}$$

SECTION 9.0

PROGRAM MESSAGES AND ERROR CODES

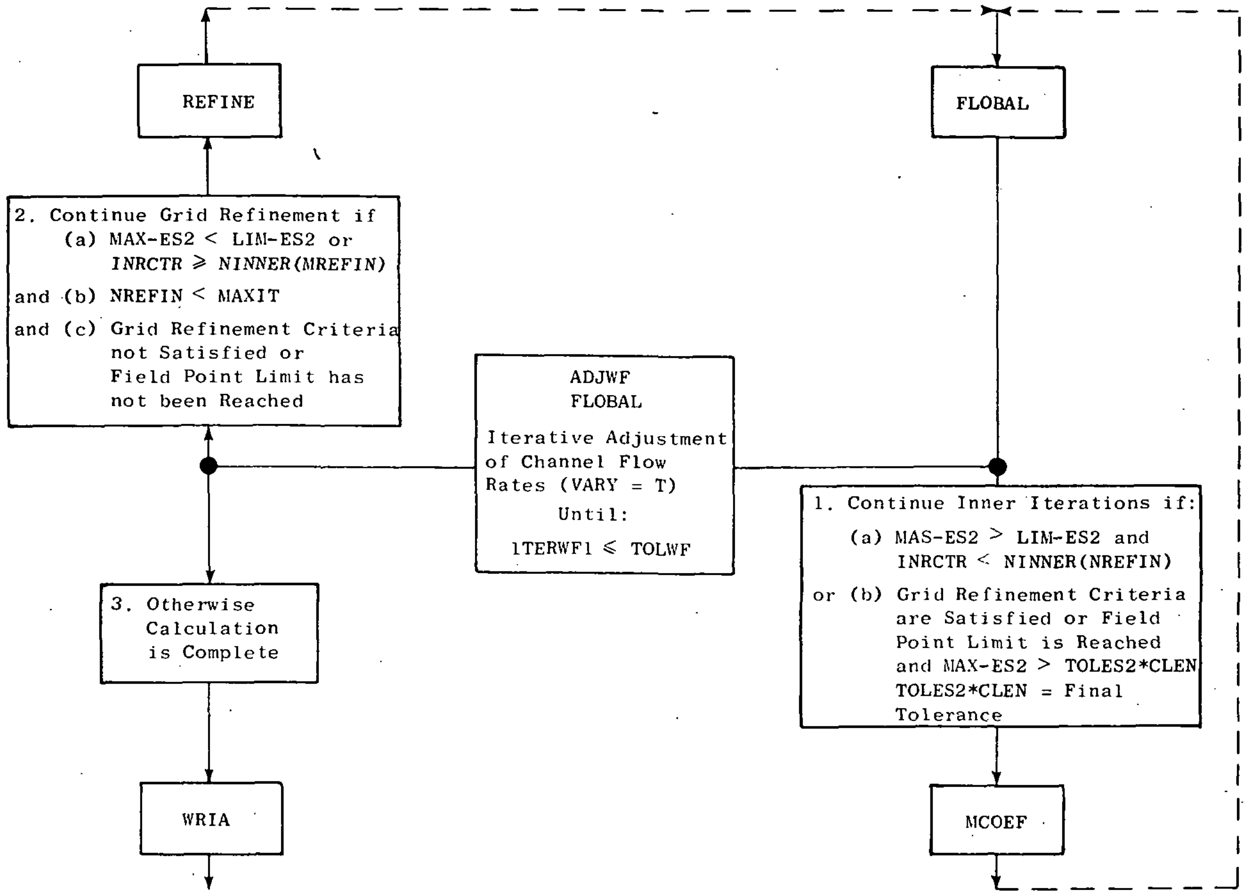
9.1 PARAMETERS DESCRIBING SOLUTION STATUS

The solution history output, described briefly in Section 8.2.3, contains a summary of how the solution is proceeding. By reviewing this solution status, the level of grid refinement and the degree of solution convergence can be readily determined. In brief, the solution history is like a "hospital patient's history" in that the general health of the calculation procedure is charted here. (See Section 12 - Sample Cases).

The grid refinement level is specified by the number of times the grid has been refined (NREFIN) and by the number of GRID PTS in the flow field. The number of grid refinements is controlled by MAXIT. The number of points in the flow field is dependent on the grid refinement criteria specified and MAXIT.

The number of inner iterations at any grid refinement level is shown by INRCTR. These are controlled by built-in tolerances on the flow balance, but the internal program control can be overridden by inputting NINNER(m) where m refers to the level of grid refinement.

The system of solution tolerances is shown schematically in Figure 29. The iteration tolerances are controlled by TOLINR, TOLES2, and TOLWF which may be input. The system starts with the maximum streamline movement (MAX-ES2) demanded by the "flow balance" in FLOBAL and compares to a specified tolerance, the "flow balance" is satisfied. At this point, the flow rates of variable channels are adjusted to satisfy the "Kutta" condition at all trailing edges by iteratively calling for a "flow balance" and a "flow adjustment" (FLOBAL and ADJWF). The summary of the flow adjustment procedure is shown under the heading "KUTTA ITERATION" in the solution history output. When no trailing edges are present, the flow adjustment procedures are bypassed, and the solution immediately calls for additional grid refinement (if the limit has not been reached. If the MAX-ES2 is not within limits, the inner iterations continue until the specified tolerance, LIM-ES2, is met (or the specified NINNER limit is reached). The specified tolerance, LIM-ES2, is controlled by TOLINR and the current grid size. Thus the "flow balance" tolerance becomes smaller as the grid refinement proceeds.



Note:
LIM-ES2 = TOLINR*(Current Grid Size)
CLEN = Characteristic Grid Interval Length;
Average of SGR's & SGZ's

Note:
MAXIT, NINNER, TOLINR, TOLES2, and
TOLWF are Input Items

Figure 29. Iteration Tolerance.

If the grid refinement (MAXIT) criterion is satisfied or the field point limit is reached, a second tolerance (TØLES2) defines a final series of inner iterations. This permits a looser tolerance (TOLINR) during the flow field grid development and then a final tight tolerance (TØLES2) for actual flow field definition. The summary of this iteration tolerance is shown as NREFIN, GRID PTS, LIM-ES2, MAX-ES2, Z, and R. The latter two parameters are the field coordinates of the maximum streamline movement point. A comparison of MAX-ES2 versus LIM-ES2 (See Section 12 - Sample Cases) normally shows decreasing values of MAX-ES2 as the solution proceeds. Any erratic behavior in MAX-ES2 indicates convergence problems.

During an inner iteration, the streamline displacement (or correction) equation is solved to adjust the streamlines in the flow field. The results of the matrix solution are shown as a maximum streamline adjustment (MAX-DS2) which is actually made and the number of sweeps (NSWEEPS) through the matrix solution (IAD or LRELAX) to reach the final solution.

The final parameter in the solution history output is NSSPTS, the number of imbedded supersonic points in the flow field. This item, in addition to the erratic behavior of MAX-ES2 may be indicative of solution convergence problems.

Under certain output options, the diagnostic printout includes a line of solution history at the end. Since the history is not summarized neatly on one page, care must be exercised in seeking out the solution history interspersed with the diagnostic output.

9.2 STC ERROR PROCESSING

In general, the occurrence of an error during processing will cause termination of the problem. Each of the main links contain an error print routine which will print the STC tables and the field tables to assist in diagnosing the problem. When the error occurs in overlays subordinate to (0,0), an illegal computed GO TO statement is executed. This will cause a MODE 4 abort and a printout of the sequence of subroutine calls preceding the error.

9.2.1 Description of Table Print Format

In general, the information stored in the STC tables consists of mixed BCD, floating point, integer, and logical data. A special routine (TABPRT) is used to print the arrays which may have a variable data format. The following conventions have been established for the output format on the CDC machines:

Data Type	Print Format
Integer	Integer (I12) Format
Floating Point	E or F Format, depending on the magnitude of the number.
BCD	Hollerith characters A6 Format
Logical	TRUE. Variables are printed as an integer -0
	FALSE. Variables are printed as an integer 0

Note that a floating point 0, an integer 0, and a logical.FALSE. are all printed as an integer 0 since the data type, in this instance, is indistinguishable. The program listings (Volume II) may be consulted to determine the true type of the data should this situation arise. A junk word BITS = 10^{15} is utilized in the STC program for testing purposes. This quantity is printed using OCTAL format (04) and appears as 0000.

Common/TROUBL/contains two logical variables ERR and INERR which may be set to.TRUE. during processing. In this situtation, the job is terminated normally in the main program. The diagnostic output is preceded by the comment ERR = T, ERRLOC = n_1, LENTRY = n_2. In this comment, n_1 and n_2 are integers denoting the location of the last overlay call in the MAIN program of OVERLAY (0,0) and the current LENTRY setting (see listings). When an error is detected in overlays subordinate to (0,0), a mode 4 error is initiated to terminate the program with a subroutine back trace following selected diagnostic output.

Since the data tables used in each overlay differ, the error print may differ slightly between links. Normally, common printed output consists of the general labeled common /ALLCOM/, the STC tables (BDYTAB, STATAB, etc.), and the field tables which include R, Z, VM, etc. The field tables are printed in tabular format by point number (M) for ease in locating computation problems.

In the STC execution overlays (2,n) and (3,n), an additional block of output is printed, consisting of the information currently in the /ERASE2/ common block, used as temporary storage by the major STC subroutines. These data are headed by the subroutine(s) currently using the temporary storage and the variable names currently applicable for common /ERASE2/.

Subroutines: BRHS, FLOBAL, WRIBDY, WRIOUT

Data are printed in tabular format along the current orthogonal line (subscript K = 1,NK)

Parameter	Description
AREA	Flow area calculated during FLOBAL iteration
AREAO	Initial FLOBAL streamtube flow areas calculated from S2 tables. AREAO(NK) is the passage flow area.
DISP	DISP(K) is the displacement thickness of the wake between streamlines K,K+1. DISP(K) = -1 for a zero thickness wake.
PT	Total pressure
LAMBDA	Fraction of unblocked circumference (axisymmetric) or lamina thickness (planar).
RHO	Density
SQRTVV	Square root of VVKQKP
TS	Static temperature
TT	Total temperature
VMSQ	Velocity squared

VVKQKP	Ratio of velocity squared on streamline K to value on streamline K+1 due to curvature and total temperature change
WQA	Flow per unit area, ρV
WSTA	Cumulative flow rate as obtained from streamline table, SLTAB.
RG	Value of the perfect gas constant for each streamline
C2CP	Two times the specific heat at constant pressure
FGR	Value of $1/(\gamma-1)$ for each streamline.

Subroutine: SLC

Data are printed in tabular format along the current streamline (subscript I = 1, NI)

Parameter	Description
CURSS	Array for calculation of streamline curvature at supersonic points
QV	Stagnation point iteration control vector
RB	Radial distance, ordinate, for points along streamline
ZB	Axial distance, abcissa, for points along streamline
ANG	Flow angle for points along streamline
CURVB	Curvature for points along streamline
S1B	Distance along streamline
BI	Subsonic - supersonic indicator for points along streamline
J2DONE	Indicator for streamlines which have been curve fit. Used for indicating delayed interpolated data at partial orthogonal termination points.
MSV	Field point index along streamline

Subroutine: PTMOVE

Values along the control streamline (I = 1,NIC)

Parameter	Description
X1L	Station number
SC	Distance along the streamline
SCX	Desired distance along the streamline. SCX is proportional to the station number.

LC	Station table index
LOOPC	Indicator for primary stations (1) and all other stations (2)
KCL	K index for the control streamline
	Values along orthogonal lines (K = 1,NK)
PHI2	Angle of the orthogonal with respect to horizontal; discrepancy in orthogonality.
DS1	Point movement along the streamline
ZK	Axial distance, abcissa
RK	Radial distance, ordinate
WEZPT	Double streamline indicator (slip lines, wakes, stagnation streamlines). WEZPT(K) = 1 if K,K+1 is a double streamline.
DS1C	Correction to DS1 to account for streamline curvature (negative [concave] curvature only)

Subroutine: REFINE

Arrays of data on streamlines (when new streamlines are being added), or along orthogonal lines (when new stations are being added).

Parameter	Description
IA	Beginning of refinement
IB	End of refinement
CR	Criteria for refinement; $C_r = R_s + R_s^{1/5} R_v$ where R_s and R_v are defined in Section 12.
DELS	Interval size of unrefined grid
DELVM	Velocity change for the unrefined interval normalized by VMG1 or VMG2
LSTA	Station index
MJ2	Field point index (M) along streamline J2
SGX	Grid size interpolated from GZ&SGZ
RAV	Average R of intervals to be refined
ZAV	Average Z of intervals to be refined

The error print is best illustrated by an example of the typical output after an error in the flow balance (overlays (2,0), (2,1)). Referring to the example, the initial output consists of the data in common /CFB/, including a variable identification key. This output is followed by the information in the streamline table commons /ALLCOM/, /CIDEX/, /IXORIG/, and the STC tables BDYTAB, CONVTB, WAKETB, CADJWF, and STATAB. (See Section 6 and 7 for definition of these commons and tables.) The field tables are printed next and include the following items:

J	Streamline number
M	Field point index
MU	Upstream field point
MD	Downstream field point
I	ISTAG value
S1	Cumulative distance along streamline
S2	Cumulative distance along orthogonal line
Z	Axial coordinate, abcissa
R	Radial or transverse coordinate, ordinate
PHI1	Flow angle (radians)
CURV	Streamline curvature
VM	Velocity
B	Coefficient B of matrix equation
RHS	Right hand side of matrix equation
DS2	Streamline adjustment

The field table output is followed by the /ERASE2/ data as described in the preceding section.

9.2.2 Location and Explanation of Specific Error Comments

As mentioned previously, input or calculation errors will result in the termination of the problem. The locations (subroutine name) and description of error conditions are given in the following table. Included are suggested corrective measures (where possible), description of comments preceding the table print, and a designation of whether the error is FATAL or NON-FATAL. Several specific problems deserve further comment. When the iterative solution of the matrix equations for streamline point movement is in trouble (NSWP → MAXSWP), a print of the solution matrix (DS2) and the maximum DS2 will start appearing in the printout. Subroutine IAD is structured to detect this problem and provide the iteration history over a complete cycle as the solution proceeds from over-relaxation to under-relaxation. In this case, the problem may usually be detected by inspection of

the solution matrix. Appropriate corrections would be to input a RHOBAS larger than the preset value or preferentially sweep the field in a single direction.

The boundary layer data tables are built by subroutine BLTBBL at the end of the problem. If a boundary layer on a given surface is specified in the boundary layer input table and there is insufficient storage in the TABLES region to accommodate all the data, the following output will occur:

TABLE SPACE EXHAUSTED--BOUNDARY LAYER DATA

FOR $\begin{matrix}\text{UPPER}\\\text{LOWER}\end{matrix}$ BOUNDARY "boundary name" NOT SAVED

The above comment serves as a warning to the user to increase the available size of the TABLES area. Following the printing of this comment, the calculation switch in the input table is turned off.

If subroutine BDYPTM detects a separated boundary layer in the course of interpolation for the displacement correction, the following comment with boundary name and separation location appears each time the boundary is accessed:

** W A R N I N G ** SEPARATED BOUNDARY LAYER, BOUNDARY = "boundary name"
SW = XXXXX

Since displacement thicknesses downstream of the separation point are in error, the user is advised to terminate the problem at this stage.

Several informative comments may appear in the printout during the course of the calculation. The specific diagnostics are as follows:

- *** THE INPUT GRID REFINEMENT CRITERIA HAVE NOT BEEN SATISFIED appears after the iteration history output if the specified grid refinement criteria have not been satisfied.

- *** THE SOLUTION HAS NOT CONVERGED TO THE INPUT INTOLERANCE appears after the iteration history output if the flow balance tolerance has not been satisfied upon completion of NINNER inner iterations.

- ISTAG =3 POINT INSERTED $\left\{\begin{matrix}\text{ABOVE}\\\text{BELOW}\end{matrix}\right\}$ L.E. OR CORNER AT (Z-loc.)(R-loc.) appears interspersed in the iteration history output when the velocity at the stagnation point becomes less than half the velocity at the adjacent point above/below the discontinuity. At this stage, the stagnation point is converted to a "hard" discontinuity.

Subroutine Name	Location Nearest Statement Number	Type	Specific Comment	Description and/or Corrective Measures
STCA	12	F	No	ERR=T. The last overlay call and LENTRY setting are given.
ATAN3	50	F	No	Check PHI1 array for spurious flow angles.
BEAM	800	F	No	Points out of order.
LSPFIT	119	F	No	Integration - XC not in same order as X. Will also occur if only 1 point in X table.
QIREM	44	F	No	Number of iterations greater than specified limit.
STANO	120	F	No	Requested station not present in the Station Table.
LBDYBL	140	F	No	Boundary layer input table full and entry not present.
STAX1	120	F	No	Requested station not present in the Station Table.
REDINP	400	F	Yes	Second field on input header card not BDY or CHN.
RBD	55	F	Yes	No coordinate input for given boundary.
RCD	950	F	Yes	Insufficient table storage for channel input table. Change limits in /USECDG/.
RELOXY	1 030	F	Yes	Number of output points from SMOTH section exceeds allocated storage.
SERS1	50	F	Yes	Series 1 contour cannot be generated. Parameter A not between 0.5 and 1.0.
BLDTAB	360	F	Yes	Boundary table not continuous. Check input.
	460	F	Yes	Leading edge, trailing edge, and boundary points cannot be ordered according to orthogonal number.
BPSORT	187	F	Yes	Coincident orthogonals.
MATINV	1	F	No	Far field solution matrix is singular.
ISBOT	510	F	No	
LFIT2D	125	F	No	X entry out of range.
TTPT	125	F	No	Properties for requested channel not present in convected property table.
BCONV	240	F	Yes	Flow rate for given channel not defined. Check channel input.
	183	N	Yes	Channel flow rate greater than choked value. Calculation continues.
	184	F	Yes	Failure of PS iteration for given flow rate.
	185	F	Yes	Static pressure exceeds total pressure for given channel.

Subroutine Name	Location Nearest Statement Number	Type	Specific Comment	Description and/or Corrective Measures (continued)
BLDTBS	517	F	Yes	Connecting edges not found for given channel.
	530	F	Yes	Connecting edges not found for given channel.
	561	F	Yes	Connecting edges not found for given channel.
	600	F	No	
	642	F	No	
	654	F	No	
	686	F	No	
	692	F	No	
	720	F	No	
	730	F	No	
	820	F	No	
	835	F	Yes	Negative radius encountered
	866	F	No	
	872	F	No	
	896	F	No	
JOFCHN	70	F	No	Streamlines bounding channel not found.
OBI	105	F	No	Channel name not present in boundary table.
	150	N	Yes	Boundary intersection not found. Point placed in an end interval.
RBCONV	190	F	Yes	Restart - Table of convected properties exceeds allocated memory.
ADJWF2	800	N	Yes	Unexpected choke at given station.
FLOBAL	532	F	No	Free boundary not permitted at upstream boundary (lower)
	534	F	No	Lower far-field boundary not permitted
	542	F	No	Free boundary not permitted at upstream boundary (upper)
	568	F	Yes	Requested pressure exceeds total pressure at trailing edge
	570	F	Yes	Maximum flow calculation and (free, pressure, far-field boundary cannot both be specified)
	590	F	No	Negative static temperature during flow balance.

Subroutine Name	Location Nearest Statement Number	Type	Specific Comment	Description and/or Corrective Measures (continued)
ADJWF	1574	N	Yes	Two adjacent channels choked.
	282	N	Yes	Choked flow rate less than user input flow rate.
NEWRAP	50	F	No	Number of Newton-Rhapson iterations exceeded (ADJWF)
BLTBBL	1000	N	Yes	Table space exhausted saving boundary layer data.
RBWAKE	200	N	Yes	Missing tailing edge-boundary layer point.
SAB	25	F	No	Boundary collation point out of range for given ZW table.
BDYPTM	75	F	Yes	Failure to locate proper interval in the boundary table.
	281	N	Yes	Separated boundary layer.
INSTA	210	F	No	
	230	F	No	
	310	F	No	
	330	F	No	
	502	F	No	Points out of order when inserting station.
PTMOVE	240	F	No	Control streamline not included in station streamlines.
	243	F	No	Control streamline does not cross orthogonal line.
	318	F	No	Failure to relocate orthogonal angles and lengths at a double streamline.
	3303	F/N	Yes	Magnitude of point movement unreasonable. Termination if NREFIN ≥ 2. Check boundary coordinates.
	338	F	No	Primary stations extend beyond the ends of boundary.
REFINE	445	N	Yes	Station table storage limit does not allow a new orthogonal at given station.
	210	N	Yes	Grid refinement deleted because of large variation in spacing.
	170	N	Yes	Streamline limit reached.
	870	N	Yes	Field point limit prevents further grid refinement.
SLC	148	F	Yes	Error in locating position of stagnation point.
	1552	F/N	Yes	SLC interchanging points. Fatal after 5 interchanges.
	457	F	No	Error in curvature calculation for ISTAG = 3 points.
	341	N	Yes	Negative L.E. curvature.

Subroutine Name	Location Nearest Statement Number	Type	Specific Comment	Description and/or Corrective Measures (concluded)
STTOFI	60	F	No	Number of mesh points on orthogonal line greater than MAXOL.
MCOEF	945	F	Yes	Far-field boundary supersonic.
IAD	100 300	F	No	Maximum streamline movement greater than characteristic grid size.
	235	F	No	Solution sweep limit exceeded.
CUFIT	120	F	No	Interval in X table not located. XC not in same order as X (integration).
CUBERS	410	F	No	Erroneous boundary conditions on cubic spline.

SOLUTION HISTORY

REFINEMENT		INNER ITERS		MATRIX SOLUTION		FLOW BALANCE ERROR				KUTTA ITERATION		
NREFIN	GRID PTS	INRCTR	NSSPTS	NSWEEPS	MAX-DS2	MAX-ES2	LIM-ES2	Z	R	TRAILING EDGE-XI2	FLOW RATE	FRACTIONAL FLOW ERROR
0	12	0	0	R	*0.000000	-.003837	2.545455	-29.666	6.919			
0	12	1	0	2	-.003837	-.008710	2.545455	-29.325	6.924			
1	50	0	0	R	*0.000000	.451249	1.095440	27.624	60.000			
1	50	1	0	11	-.325305	.087161	1.095440	27.418	60.206			
2	113	0	0	R	*0.000000	-.286434	.566979	-7.259	5.217			
2	113	1	0	16	-.204912	.031039	.566979	27.320	60.233			
3	197	0	0	R	*0.000000	-.294517	.284207	-3.649	7.290			
3	197	1	0	11	-.119539	.066406	.284207	-3.635	7.174			
4	265	0	0	R	*0.000000	-.269201	.168107	-1.810	7.366			
4	265	1	0	11	-.083984	.062263	.168107	-1.798	7.305			
5	341	0	0	R	*0.000000	-.431686	.127707	.101	6.567			
5	341	1	0	15	-.095148	-.113210	.127707	.088	6.472			
6	470	0	0	R	*0.000000	-.517976	.088207	.052	6.472			
6	470	1	0	32	-.090157	.183313	.088207	-.320	6.962			
6	470	2	0	40	.027101	-.383545	.088207	-.347	6.987			
6	470	3	0	37	-.036920	-.182024	.088207	-.340	6.405			
6	470	4	0	32	-.012105	-.039934	.088207	-.344	6.392			
7	578	0	5	R	*0.000000	.224877	.058997	-.215	8.099			
7	578	1	2	22	.079229	.456704	.058997	-.364	7.220			

UNEXPECTED CHOKE, STATION(XI1)=16.000 L= 590

CFB 1-L,MA,MB 4-PLB,PUB,WF,CHOKE,SUBSON 9-NK,PLBC,PUBC,XCHOKE,TAREA,VMBC,WRQST,WCALC 17-QV(8),QVP(8) 33-JSUM,VMLBSQ

0		590	289	299	0	0	0	0
8	-0	11	18.685167	14.541246	CHOKE	163.162198	1609.738	2.854917
16	2.815030	9.000000	1605.754	1613.017	1625.804	0	-1.8082E-05	-1.8052E-05
24	-1.9483E-05	0						
32	TROUBL	3073	0					

STREAMLINE TABLE-

J	X2	SLCHN	W
1	0.000000	W2	0.000000
2	.500000	W2	.138262
3	1.000000	W2	.276524
4	2.000000	W2	.553047
5	3.000000	W2	.829571
6	4.000000	W2	1.106095
7	5.000000	W2	1.382618
8	6.000000	W2	1.659142
9	6.500000	W2	1.797404
10	7.000000	W2	1.935666
11	7.500000	W2	2.073928
12	8.000000	W2	2.212190
13	8.000000	EXT	0.000000
14	8.007813	EXT	.160682
15	8.015625	EXT	.321364
16	8.023438	EXT	.482045

17	8.031250	EXT	.642727
18	8.046875	EXT	.964091
19	8.062500	EXT	1.285454
20	8.125000	EXT	2.570908
21	8.250000	EXT	5.141817
22	8.500000	EXT	10.283634
23	9.000000	EXT	20.567267
24	10.000000	EXT	41.134535
25	11.000000	EXT	61.701802
26	12.000000	EXT	82.269070
27	14.000000	EXT	123.403604
28	16.000000	EXT	164.538139

ALLCOM

1	.800000	14.695940	518.688000	1.000000	585.080064	-0	1716.200	1.400000
9	.800000	14.695940	518.688000	22.401609	585.080064	0000	1716.200	0000
17	0	1.000000	0	-0				

CIDEX

1	300	28	283	307	1

IXORIG

1	1	20
3	21	231
5	232	269
7	270	269
9	270	269
11	270	1173

BDYTAB

21	CNTLN	12	0
24	W2	0	0
27	-30.000000	0	0
30	18.000000	0	0
33	NACA1	186	6
36	W2	EXT	57
39	NACA1	6	57
42	CLEX	57	177
45	18.000000	8.400000	3.207758
48	16.200000	8.262330	3.228091
51	14.400000	8.091780	3.241809
54	10.800000	7.733290	3.231861
57	8.100000	7.529710	3.199538
60	6.300000	7.448560	3.173916
63	4.500000	7.413000	3.159220
66	2.500000	7.378000	3.158959
69	.761000	7.348000	3.127089
72	.534000	7.361630	3.025877
75	.383000	7.387280	2.913286
78	.198000	7.451810	2.679988
81	.115600	7.501360	2.512733
84	.083200	7.527230	2.419847
87	.054040	7.556030	2.298442
90	.037900	7.575930	2.203461
93	.017210	7.610000	2.023395
96	0	7.682000	1.570796
99	.001908	7.696762	1.316423
102	.005512	7.707042	1.153397
105	.011630	7.718245	.995129
108	.023396	7.733138	.822100
111	.036056	7.745223	.709076

114	.071395	7.769920	.529693
117	.108036	7.788982	.438062
120	.144000	7.804730	.390284
123	.180000	7.818887	.359559
126	.270000	7.849743	.305627
129	.360000	7.876350	.272841
132	.450000	7.900506	.253163
135	.540000	7.923164	.240028
138	.630000	7.944683	.228989
141	.720000	7.965145	.218320
144	.810000	7.984605	.208171
147	.900000	8.003166	.199075
150	1.080000	8.038038	.184261
153	1.260000	8.070520	.173171
156	1.440000	8.101178	.164602
159	1.620000	8.130378	.157288
162	1.800000	8.158300	.150289
165	2.160000	8.210347	.136448
168	2.520000	8.257360	.123662
171	2.880000	8.299988	.113200
174	3.240000	8.339403	.105501
177	3.600000	8.376532	.099843
180	3.960000	8.411795	.095178
183	4.500000	8.461576	.088892
186	5.400000	8.537374	.079679
189	6.300000	8.605598	.071748
192	7.200000	8.667152	.064719
195	8.100000	8.722533	.058317
198	9.000000	8.772261	.052338
201	10.800000	8.856167	.041011
204	12.600000	8.920332	.030191
207	14.400000	8.965358	.019695
210	16.200000	8.991629	.009565
213	18.000000	9.000000	0
216	27.500000	9.000000	0
219	FF	12	0
222	EXT	-0	0
225	28.000000	60.000000	3.141593
228	-30.000000	60.000000	3.141593

CONVTB

232	W2	19	1	15	16	17	18
239	1716.200	6006.700	12013.400	00	.285714	3.500000	2.500000
246	150.040333	2.212190	585.080064	22.401609	0		
251	EXT	19	1	15	16	17	18
258	1716.200	6006.700	12013.400	00	.285714	3.500000	2.500000
265	11159.693	164.538139	585.080064	22.401609	0		

WAKETB

CADJWF

STATAB

270	0	20	1	14	1
275	SOLID	CNTLN	1	.014166	.679969
280	FARFLD	FF	1	1.000000	58.000000
285	890.946057	1.3379E-07	8.000000	0	4
290	4.000000	20	15	28	0
295	SOLID	CNTLN	1	.167255	8.028228

300	FARFLD	FF	0	0000	0000
305	891.382260	1.3379E-07	0000	0	18
310	8.000000	20	29	44	0
315	SOLID	CNTLN	1	.320533	15.385564
320	FARFLD	FF	0	0000	0000
325	891.658286	1.3379E-07	0000	0	33
330	10.000000	20	45	62	0
335	SOLID	CNTLN	1	.397483	19.079173
340	FARFLD	FF	0	0000	0000
345	891.874595	1.3379E-07	0000	0	51
350	12.000000	20	63	82	0
355	SOLID	CNTLN	1	.474958	22.797980
360	FARFLD	FF	0	0000	0000
365	892.145616	1.3379E-07	0000	0	70
370	13.000000	20	83	97	0
375	SOLID	CNTLN	1	.514094	24.676506
380	FIELD		0	0000	0000
385	879.939852	1.3379E-07	0000	0	90
390	13.500000	20	98	111	0
395	SOLID	CNTLN	1	.533850	25.624796
400	FIELD		0	0000	0000
405	827.675288	1.3379E-07	0000	0	106
410	14.000000	20	112	135	0
415	SOLID	CNTLN	1	.553775	26.581196
420	FARFLD	FF	0	0000	0000
425	892.463492	1.3379E-07	0000	0	121
430	14.500000	20	136	154	0
435	SOLID	CNTLN	1	.573378	27.522137
440	FIELD		0	0000	0000
445	871.232760	1.3379E-07	0000	0	145
450	14.750000	20	155	174	0
455	SOLID	CNTLN	1	.583100	27.988823
460	FIELD		0	0000	0000
465	820.067510	1.3379E-07	0000	0	166
470	15.000000	20	175	197	0
475	SOLID	CNTLN	1	.592486	28.439315
480	FIELD		0	0000	0000
485	884.296981	1.3379E-07	0000	0	186
490	15.250000	20	198	218	0
495	SOLID	CNTLN	1	.601586	28.876111
500	FIELD		0	0000	0000
505	858.066690	1.3379E-07	0000	0	209
510	15.500000	20	219	240	0
515	SOLID	CNTLN	1	.610197	29.289440
520	FIELD		0	0000	0000
525	877.231469	1.3379E-07	0000	0	230
530	15.625000	20	241	256	0
535	FIELD		0	0000	0000
540	FIELD		0	0000	0000
545	781.933362	1.3379E-07	0000	0	249
550	15.750000	20	257	277	0
555	SOLID	CNTLN	1	.618333	29.679989
560	FIELD		0	0000	0000

565	864.594614	1.3379E-07	0000	0	268
570	15.875000	20	278	288	0
575	FIELD		0	0000	0000
580	FIELD		0	0000	0000
585	903.551768	1.3379E-07	0000	1.000000	283
590	16.000000	22	289	300	1
595	SOLID	CNTLN	1	.626168	30.056082
600	LE	NACA1	16	.992470	.039613
605	380.136326	1.1958E-05	8.000000	0	300
610	4.918455	.454095			
612	16.125000	20	301	307	0
617	FIELD		0	0000	0000
622	SOLID	NACA1	11	.822464	.161412
627	507.156480	4.8481E-06	0000	1.000000	307
632	16.250000	20	308	319	0
637	SOLID	CNTLN	1	.635264	30.492667
642	SOLID	NACA1	10	.252181	.038658
647	940.532534	4.7170E-06	0000	1.000000	319
652	16.500000	20	320	331	0
657	SOLID	CNTLN	1	.647997	31.103849
662	SOLID	NACA1	8	.835421	1.453055
667	706.635194	4.8032E-06	0000	0	331
672	16.750000	20	332	343	0
677	SOLID	CNTLN	1	.659772	31.669057
682	SOLID	NACA1	8	.517742	.900520
687	735.291088	5.1614E-06	0000	0	343
692	17.000000	20	344	355	0
697	SOLID	CNTLN	1	.671361	32.225315
702	SOLID	NACA1	8	.200078	.347993
707	697.511458	5.2832E-06	0000	0	355
712	17.250000	20	356	365	0
717	SOLID	CNTLN	1	.682847	32.776660
722	SOLID	NACA1	7	.897747	1.795770
727	693.304778	5.3704E-06	0000	0	365
732	17.500000	20	366	375	0
737	SOLID	CNTLN	1	.694389	33.330665
742	SOLID	NACA1	7	.621526	1.243241
747	690.068532	5.4037E-06	0000	0	375
752	18.000000	20	376	384	0
757	SOLID	CNTLN	1	.717587	34.444195
762	SOLID	NACA1	7	.069082	.138185
767	685.218607	5.4488E-06	0000	0	384
772	19.000000	20	385	392	0
777	SOLID	CNTLN	1	.764913	36.715838
782	SOLID	NACA1	5	.849289	1.530306
787	684.687604	5.5226E-06	0000	0	392
792	20.000000	20	393	400	0
797	SOLID	CNTLN	1	.812648	39.007094
802	SOLID	NACA1	4	.748958	2.027990
807	647.075923	5.9436E-06	0000	0	400
812	21.000000	20	401	406	0
817	SOLID	CNTLN	1	.860754	41.316177
822	SOLID	NACA1	3	.949662	3.435705

827	604.920724	6.4003E-06	0000	0	406
832	22.000000	20	407	412	0
837	SOLID	CNTLN	1	.907373	43.553910
842	SOLID	NACA1	3	.338765	1.225588
847	554.341329	6.9175E-06	0000	0	412
852	24.000000	20	413	418	1
857	SOLID	CNTLN	1	.998661	47.935747
862	SOLID	NACA1	1	.231836	.418537
867	486.789585	7.6621E-06	0000	0	418
872	16.000000	22	419	434	1
877	LE	NACA1	16	.992470	.039613
882	FARFLD	FF	1	.496816	28.815339
887	892.736961	1.3423E-07	8.000000	0	419
892	4.918455	.454095			
894	16.187500	20	435	443	0
899	SOLID	NACA1	25	.240249	.009434
904	FIELD		0	0000	0000
909	868.861986	1.3423E-07	0000	1.000000	435
914	16.375000	20	444	452	0
919	SOLID	NACA1	28	.547260	.051363
924	FIELD		0	0000	0000
929	874.066751	1.3423E-07	0000	1.000000	444
934	16.562500	20	453	461	0
939	SOLID	NACA1	30	.867835	.080543
944	FIELD		0	0000	0000
949	878.624637	1.3423E-07	0000	1.000000	453
954	16.750000	20	462	471	0
959	SOLID	NACA1	33	.207441	.019101
964	FIELD		0	0000	0000
969	884.957711	1.3423E-07	0000	1.000000	462
974	17.125000	20	472	480	0
979	SOLID	NACA1	36	.460404	.084212
984	FIELD		0	0000	0000
989	889.001996	1.3423E-07	0000	0	472
994	17.500000	20	481	491	0
999	SOLID	NACA1	38	.828806	.151136
1004	FIELD		0	0000	0000
1009	891.535667	1.3423E-07	0000	0	481
1014	18.250000	20	492	501	0
1019	SOLID	NACA1	41	.792543	.287740
1024	FIELD		0	0000	0000
1029	893.727375	1.3423E-07	0000	0	492
1034	19.000000	20	502	515	0
1039	SOLID	NACA1	44	.179226	.064864
1044	FARFLD	FF	0	0000	0000
1049	893.173772	1.3423E-07	0000	0	502
1054	20.500000	20	516	522	0
1059	SOLID	NACA1	47	.585311	.528646
1064	FIELD		0	0000	0000
1069	899.727887	1.3423E-07	0000	0	516
1074	22.000000	20	523	534	0
1079	SOLID	NACA1	49	.501692	.452578
1084	FARFLD	FF	0	0000	0000

1089	893.577221	1.3423E-07	0000	0	523
1094	25.000000	20	535	545	0
1099	SOLID	NACA1	52	.669720	1.206809
1104	FARFLD	FF	0	0000	0000
1109	893.943688	1.3423E-07	0000	0	535
1114	28.000000	20	546	556	0
1119	SOLID	NACA1	54	.590423	1.063098
1124	FARFLD	FF	0	0000	0000
1129	894.262571	1.3423E-07	0000	0	546
1134	34.000000	20	557	567	0
1139	SOLID	NACA1	57	.271703	2.581175
1144	FARFLD	FF	0	0000	0000
1149	894.747995	1.3423E-07	0000	0	557
1154	40.000000	20	568	578	1
1159	SOLID	NACA1	57	1.000000	9.500000
1164	FARFLD	FF	1	.008533	.494901
1169	895.414804	1.3559E-07	0000	0	568

STREAMTUBE CURVATURE PROGRAM

IDENT= NASA INLET CONFIGURATION NO. 8

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
1	1	0	15	0	.000006	0.000000	-29.320031	0.000000	0.000000	0.0000000	890.946	85.288	0.00000	0.00000
4	2	0	16	0	.000005	3.456902	-29.321219	3.456901	.000687	-.0000000	890.946	60.308	-.00007	.00000
6	3	0	17	0	.000004	4.888797	-29.322396	4.888797	.000960	-.0000000	890.946	42.644	.00000	.00000
12	4	0	18	0	0.000000	6.913804	-29.324773	6.913802	.001385	0.0000000	890.946	24.980	0.00000	.00000
13	5	0	19	0	0.000000	6.913804	-29.324773	6.913802	.001385	0.0000000	890.946	40.122	-.00000	.00000
20	6	0	20	0	.000002	10.166245	-29.330242	10.166238	.001963	-.0000000	890.946	70.215	-.00000	.00000
21	7	0	21	0	-.000003	12.605729	-29.335519	12.605717	.002341	.0000000	890.946	77.293	.00000	.00000
22	8	0	22	0	-.000018	16.431926	-29.345450	16.431901	.002893	.0000000	890.946	118.181	-.00000	.00001
23	9	0	23	0	-.000013	22.185940	-29.364349	22.185884	.003533	.0000000	890.946	174.831	.00000	.00001
24	10	0	24	0	-.000104	30.604444	-29.395886	30.604328	.004023	.0000000	890.946	184.749	.00000	.00001
25	11	0	25	0	-.000111	37.162460	-29.422894	37.162288	.004063	.0000000	890.946	149.524	.00000	.00001
26	12	0	26	0	-.000155	42.725463	-29.444982	42.725247	.003924	.0000000	890.946	184.255	.00000	.00001
27	13	0	27	0	-.000186	52.098935	-29.480156	52.098654	.003478	.0000000	890.946	213.419	.00000	.00002
28	14	0	28	0	-.000219	60.026102	-29.505600	60.025780	.002941	.0000000	890.946	4022.501	-.00101	.00002
1	15	1	29	0	7.348265	0.000000	-21.971772	0.000000	0.000000	0.0000000	883.083	88.675	0.00000	0.00000
4	16	2	31	0	7.347859	3.462526	-21.973367	3.462525	.000921	-.0000636	883.176	62.680	.00005	.00001
6	17	3	32	0	7.347463	4.896700	-21.974942	4.896698	.001307	-.0000944	883.276	44.288	.00004	.00001
12	18	4	33	0	7.346625	6.924841	-21.978156	6.924836	.001735	-.0000951	883.454	25.936	0.00000	.00001
13	19	5	34	0	7.346625	6.924841	-21.978156	6.924836	.001735	-.0000951	883.454	41.602	.00004	.00001
20	20	6	36	0	7.345595	10.182054	-21.984666	10.182042	.002528	-.0001540	883.808	72.747	.00001	.00002
21	21	7	37	0	7.343752	12.624825	-21.991790	12.624802	.003114	-.0002104	884.203	79.850	-.00001	.00002
22	22	8	38	0	7.340747	16.455461	-22.004722	16.455416	.003825	-.0002539	884.998	121.558	-.00007	.00003
23	23	9	39	0	7.334676	22.214287	-22.029715	22.214187	.004511	-.0002666	886.341	178.591	-.00016	.00004
24	24	10	40	0	7.327623	30.635983	-22.068226	30.635795	.004836	-.0002218	888.197	187.488	-.00010	.00006
25	25	11	41	0	7.322694	37.193784	-22.100155	37.193518	.004668	-.0001651	889.331	150.777	-.00007	.00006
26	26	12	42	0	7.319824	42.755392	-22.125064	42.755070	.004375	-.0001234	890.040	184.889	-.00006	.00006
27	27	13	43	0	7.316375	52.125212	-22.163641	52.124812	.003769	-.0000795	890.861	213.519	-.00008	.00005
28	28	14	44	0	7.314135	60.048391	-22.191279	60.047943	.003208	-.0000728	891.382	4012.411	-.00346	.00005
1	29	15	45	0	14.705601	0.000000	-14.614436	0.000000	0.000000	0.0000000	868.750	67.092	0.00000	0.00000
3	30	0	46	0	-.001142	2.456209	-14.617024	2.456205	.002107	.0000003	868.537	47.465	.00004	-.00001
4	31	16	47	0	14.701882	3.473618	-14.619353	3.473611	.002446	-.0003511	868.681	33.536	-.00014	-.00002
6	32	17	49	0	14.698812	4.912266	-14.623611	4.912251	.003387	-.0004717	869.194	47.293	-.00007	-.00002
12	33	18	51	0	14.693251	6.946245	-14.631565	6.946213	.004910	-.0007693	870.269	27.661	0.00000	-.00002
13	34	19	52	0	14.693251	6.946245	-14.631565	6.946213	.004910	-.0007693	870.269	24.230	-.00014	-.00002
19	35	0	53	0	-.001042	8.733423	-14.642609	8.733354	.007049	.0000005	870.591	44.237	.00029	-.00000
20	36	20	54	0	14.677469	10.212191	-14.652859	10.212087	.006673	-.0009765	871.234	52.927	-.00014	.00001
21	37	21	55	0	14.665837	12.660426	-14.669797	12.660263	.007531	-.0009961	873.364	83.885	-.00009	.00004
22	38	22	56	0	14.644569	16.496836	-14.701023	16.496544	.008316	-.0009760	876.694	126.167	-.00037	.00009
23	39	23	57	0	14.615335	22.259378	-14.749198	22.258885	.008426	-.0008090	881.236	182.741	-.00020	.00016
24	40	24	58	0	14.579111	30.679838	-14.816869	30.679075	.007429	-.0004935	886.071	189.844	-.00026	.00018
25	41	25	59	0	14.560890	37.233805	-14.862067	37.232887	.006384	-.0003091	888.377	151.509	-.00018	.00017
26	42	26	60	0	14.549723	42.791714	-14.895252	42.790697	.005587	-.0002118	889.648	185.068	-.00016	.00015
27	43	27	61	0	14.537884	52.155577	-14.942193	52.154444	.004485	-.0001186	890.984	213.371	-.00019	.00012
28	44	28	62	0	14.530652	60.074232	-14.974807	60.073034	.003753	-.0000783	891.658	4004.865	-.00965	.00009

IDENT= NASA INLET CONFIGURATION NO. 8

STREAMTUBE CURVATURE PROGRAM

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
1	45	29	63	0	18.399210	0.000000	-10.920827	0.000000	0.000000	0.0000000	851.690	72.352	0.00000	0.00000
3	46	30	65	0	3.690618	2.465840	-10.925277	2.465830	.003608	-.0008134	852.542	51.015	-.00087	-.00009
4	47	31	66	0	18.391770	3.486868	-10.929491	3.486846	.005221	-.0011531	853.403	26.304	-.00086	-.00011
5	48	0	67	0	-.001461	4.270166	-10.934830	4.270122	.007728	.0000014	853.804	20.997	.00068	-.00012
6	49	32	68	0	18.382847	4.930420	-10.939623	4.930360	.007104	-.0015465	854.277	25.650	-.00134	-.00012
8	50	0	69	0	-.001357	6.037835	-10.949188	6.037729	.010040	.0000018	854.911	29.559	.00067	-.00012
12	51	33	70	0	18.366563	6.971271	-10.958340	6.971121	.009110	-.0015176	855.344	13.504	0.00000	-.00012
13	52	34	71	0	18.366563	6.971271	-10.958340	6.971121	.009110	-.0015176	855.344	25.765	-.00108	-.00012
19	53	35	73	0	3.666750	8.763694	-10.974942	8.763466	.010532	-.0018999	858.014	46.841	-.00024	-.00009
20	54	36	74	0	18.338526	10.245553	-10.991957	10.245225	.012022	-.0019460	860.468	55.456	-.00045	-.00004
21	55	37	75	0	18.312729	12.697247	-11.023092	12.696720	.013113	-.0020653	864.742	86.973	-.00094	.00004
22	56	38	76	0	18.272243	16.535918	-11.073557	16.535058	.013448	-.0018532	871.318	129.058	-.00090	.00018
23	57	39	77	0	18.214205	22.296794	-11.150515	22.295421	.012149	-.0012597	879.135	184.513	-.00022	.00031
24	58	40	78	0	18.160572	30.710867	-11.235535	30.709066	.009380	-.0005958	885.822	190.323	-.00075	.00031
25	59	41	79	0	18.129648	37.259767	-11.293396	37.257714	.007551	-.0003445	888.454	151.391	-.00030	.00026
26	60	42	80	0	18.114364	42.814162	-11.330675	42.811986	.006366	-.0002252	889.839	184.806	-.00024	.00022
27	61	43	81	0	18.095631	52.173476	-11.384487	52.171149	.004905	-.0001178	891.214	213.056	-.00029	.00016
28	62	44	82	0	18.085640	60.089272	-11.419845	60.086867	.004029	-.0000771	891.875	3999.206	-.00505	.00013
1	63	45	83	0	22.118017	0.000000	-7.202020	0.000000	0.000000	0.0000000	819.292	58.392	0.00000	0.00000
2	64	0	84	0	-.001331	1.759082	-7.208549	1.759056	.007424	.0000015	818.440	41.360	.00030	-.00007
3	65	46	85	0	7.401331	2.487769	-7.214633	2.487717	.008970	-.0020767	819.017	29.166	-.00124	-.00010
4	66	47	86	0	22.096091	3.517633	-7.225304	3.517519	.012265	-.0026500	821.069	30.020	-.00173	-.00015
5	67	48	87	0	3.697558	4.307144	-7.236002	4.306955	.014419	-.0036190	823.095	23.820	-.00174	-.00018
6	68	49	88	0	22.076540	4.972168	-7.246178	4.971898	.016675	-.0036361	825.071	28.825	-.00205	-.00020
8	69	50	89	0	3.681200	6.086410	-7.266961	6.085942	.019201	-.0049768	829.056	32.883	-.00285	-.00022
12	70	51	90	0	22.039876	7.024216	-7.285427	7.023561	.021824	-.0054052	833.143	14.906	0.00000	-.00021
13	71	52	91	0	22.039876	7.024216	-7.285427	7.023561	.021824	-.0054052	833.143	14.967	-.00243	-.00021
17	72	0	92	0	-.001640	7.975482	-7.309147	7.974523	.026608	.0000077	834.461	28.231	.00138	-.00019
19	73	53	93	0	7.311294	8.824055	-7.330912	8.822820	.024334	-.0056741	836.558	36.105	-.00249	-.00015
20	74	54	94	0	21.964407	10.310624	-7.366662	10.308958	.025165	-.0053037	843.469	59.294	-.00356	-.00006
21	75	55	95	0	21.905629	12.765232	-7.430820	12.762727	.025182	-.0046530	853.870	90.756	-.00369	.00014
22	76	56	96	0	21.826617	16.601072	-7.519745	16.597539	.022549	-.0032678	866.889	131.432	-.00070	.00045
23	77	57	97	0	21.726016	22.351385	-7.639082	22.346621	.017230	-.0016340	878.882	184.880	.00028	.00063
24	78	58	131	0	21.647486	30.750905	-7.748811	30.745426	.011484	-.0006109	886.524	189.669	-.00052	.00049
25	79	59	132	0	21.604915	37.291840	-7.818244	37.286002	.008719	-.0003280	889.065	150.787	-.00016	.00038
26	80	60	133	0	21.584882	42.841388	-7.860237	42.835395	.007113	-.0002053	890.356	184.241	-.00016	.00030
27	81	61	134	0	21.560626	52.194995	-7.919536	52.188821	.005286	-.0001022	891.581	212.548	-.00017	.00022
28	82	62	135	0	21.548150	60.107517	-7.957364	60.101256	.004276	-.0000655	892.146	3992.210	-.00100	.00018
1	83	63	98	0	23.996543	0.000000	-5.323494	0.000000	0.000000	0.0000000	788.629	65.422	0.00000	0.00000
2	84	64	99	0	1.875504	1.774207	-5.331775	1.774188	.009340	-.0020426	790.173	46.069	-.00276	.00016
3	85	65	100	0	9.276943	2.508554	-5.340037	2.508490	.013357	-.0026030	791.526	32.302	-.00565	.00022
4	86	66	101	0	23.964707	3.546151	-5.356907	3.545949	.018640	-.0041744	794.305	33.179	-.00589	.00028
5	87	67	102	0	5.560797	4.341288	-5.373078	4.340921	.022481	-.0050338	797.235	26.257	-.00513	.00029
6	88	68	103	0	23.933942	5.010755	-5.389176	5.010192	.025129	-.0054672	800.040	31.653	-.00706	.00025
8	89	69	105	0	5.529209	6.131800	-5.419505	6.130820	.029860	-.0065578	805.516	36.001	-.00902	.00013
12	90	70	106	0	23.876532	7.074779	-5.449454	7.073319	.032674	-.0064083	810.518	16.287	0.00000	.00001
13	91	71	107	0	23.876532	7.074779	-5.449454	7.073319	.032674	-.0064083	810.518	16.182	-.00858	.00001
17	92	72	109	0	1.827062	8.029960	-5.481232	8.027967	.034481	-.0086182	816.550	30.289	-.00986	-.00007
19	93	73	110	0	9.131371	8.880362	-5.511677	8.877819	.036837	-.0080648	822.362	38.072	-.01561	-.00010
20	94	74	111	0	23.764447	10.368186	-5.567494	10.364595	.037640	-.0085581	832.694	61.552	-.01061	.00009
21	95	75	128	0	23.679570	12.821195	-5.657686	12.815949	.035530	-.0070143	848.824	92.373	-.00940	.00036
22	96	76	129	0	23.565786	16.649315	-5.781149	16.642092	.028922	-.0040610	866.755	131.599	-.00321	.00077
23	97	77	130	3	23.443916	22.387535	-5.921480	22.378610	.020002	-.0015925	879.940	149.103	0.00000	.00086

IDENT= NASA INLET CONFIGURATION NO. 8

STREAMTURE CURVATURE PROGRAM

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
1	98	83	112	0	24.944833	0.000000	-4.375204	0.000000	0.000000	0.0000000	772.691	69.231	0.00000	0.00000
2	99	84	113	0	2.822197	1.783910	-4.385132	1.783903	.011139	-.0017562	773.807	48.805	-.00354	.00042
3	100	85	114	0	10.221134	2.522358	-4.395048	2.522294	.015877	-.0027272	775.082	34.252	-.00427	.00062
4	101	86	115	0	24.906534	3.565641	-4.415281	3.565391	.022686	-.0044139	777.927	35.176	-.00167	.00087
5	102	87	116	0	6.498740	4.364911	-4.435430	4.364411	.027820	-.0063500	781.240	27.787	-.00008	.00100
6	103	88	117	0	24.868025	5.037391	-4.455467	5.036595	.032000	-.0092468	785.492	23.592	.00597	.00101
7	104	0	118	0	-.000480	5.628899	-4.476142	5.627739	.038450	.0000058	787.649	20.827	-.00659	.00089
8	105	89	119	0	6.452199	6.163244	-4.497034	6.161676	.037568	-.0101489	789.849	26.936	-.00255	.00081
12	106	90	121	0	24.794861	7.109156	-4.531744	7.106941	.041577	-.0129941	799.760	17.088	0.00000	.00053
13	107	91	122	0	24.794861	7.109156	-4.531744	7.106941	.041577	-.0129941	799.760	8.755	-.01179	.00053
15	108	0	123	0	-.002292	7.603298	-4.554337	7.600553	.047773	.0000485	801.383	16.905	.00016	.00033
17	109	92	124	0	2.733303	8.066650	-4.575687	8.063421	.044527	-.0135537	804.042	22.844	-.01707	.00021
19	110	93	126	0	10.029796	8.918828	-4.614015	8.914732	.046000	-.0123378	812.975	39.312	-.04150	.00004
20	111	94	127	3	24.649669	10.407425	-4.683054	10.401725	.046804	-.0121504	827.675	47.926	0.00000	.00020

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
1	112	98	136	0	25.901233	0.000000	-3.418804	0.000000	0.000000	0.0000000	755.781	73.396	0.00000	0.00000
2	113	99	137	0	3.777462	1.795221	-3.429934	1.795215	.012408	-.0008988	756.287	51.827	-.00084	.00074
3	114	100	138	0	11.175281	2.538578	-3.441038	2.538503	.017913	-.0015386	756.964	36.497	.00549	.00112
4	115	101	139	0	25.857447	3.589079	-3.464656	3.588756	.026252	-.0030806	758.742	37.588	.01365	.00163
5	116	102	140	0	7.446400	4.394074	-3.488215	4.393416	.033185	-.0049668	761.182	29.812	.01911	.00195
6	117	103	141	0	25.811199	5.071555	-3.512904	5.070452	.039355	-.0063471	764.053	25.363	.02028	.00212
7	118	104	142	0	.938656	5.667132	-3.537768	5.665511	.043799	-.0113966	768.040	22.278	.01931	.00213
8	119	105	143	0	7.387875	6.203988	-3.562223	6.201807	.048823	-.0139062	773.547	19.974	.01280	.00198
10	120	0	144	0	-.001293	6.696567	-3.588519	6.693674	.057137	.0000238	776.108	18.259	.00349	.00172
12	121	106	145	0	25.713189	7.154632	-3.614481	7.151007	.054886	-.0159807	778.121	8.765	0.00000	.00150
13	122	107	146	0	25.713189	7.154632	-3.614481	7.151007	.054886	-.0159807	778.121	9.368	-.08725	.00150
15	123	108	148	0	.911538	7.651235	-3.641685	7.646860	.056563	-.0192841	785.051	17.922	-.01520	.00123
17	124	109	149	0	3.641557	8.115479	-3.668654	8.110311	.059744	-.0199539	792.558	16.478	-.01675	.00095
18	125	0	150	0	-.003326	8.553203	-3.696386	8.547136	.066263	.0001270	795.817	15.358	.00028	.00085
19	126	110	151	0	10.922229	8.968718	-3.722833	8.961826	.060888	-.0210389	799.533	32.920	-.03592	.00062
20	127	111	152	0	25.522344	10.457158	-3.811592	10.447625	.058954	-.0156922	821.646	63.867	-.04953	.00084
21	128	95	153	0	25.393217	12.901607	-3.945588	12.888440	.049877	-.0097301	847.256	92.889	-.02076	.00102
22	129	96	154	0	25.240423	16.712697	-4.107389	16.696160	.035631	-.0039500	868.690	130.449	-.00550	.00131
23	130	97	197	0	25.098020	22.432568	-4.267752	22.413853	.022603	-.0015522	881.672	182.251	-.00173	.00113
24	131	78	430	0	24.978872	30.806850	-4.417684	30.786856	.013323	-.0004929	888.208	187.550	-.00116	.00071
25	132	79	431	0	24.933574	37.337064	-4.489727	37.316705	.009688	-.0002537	890.168	149.722	-.00030	.00051
26	133	80	432	0	24.906611	42.880612	-4.538599	42.860058	.007708	-.0001527	891.149	183.421	-.00028	.00039
27	134	81	433	0	24.881876	52.227615	-4.598335	52.206892	.005580	-.0000743	892.045	211.887	-.00029	.00028
28	135	82	434	0	24.867478	60.136594	-4.638069	60.115783	.004469	-.0000508	892.463	3984.130	.00191	.00023

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
1	136	112	155	0	26.842174	0.000000	-2.477863	0.000000	0.000000	0.0000000	741.564	77.077	0.00000	0.00000
2	137	113	156	0	4.718312	1.807136	-2.489158	1.807051	.012502	.0007001	741.095	54.565	.00955	.00089
3	138	114	157	0	12.115924	2.555850	-2.500552	2.555660	.018171	.0009914	740.624	38.669	.03308	.00134
4	139	115	158	0	26.797804	3.614717	-2.524644	3.614223	.027302	.0008466	739.846	40.086	.06190	.00194
5	140	116	159	0	8.385242	4.426934	-2.549940	4.426022	.035507	.0000200	739.537	32.079	.07827	.00231
6	141	117	160	0	26.747912	5.110993	-2.577007	5.109526	.043496	-.0024944	740.101	27.515	.08080	.00253
7	142	118	161	0	1.871983	5.712643	-2.605527	5.710483	.051693	-.0055195	741.865	24.369	.07689	.00270
8	143	119	162	0	8.315760	6.255304	-2.635717	6.252291	.059206	-.0084669	744.601	21.959	.06122	.00281
10	144	120	164	0	.922253	6.752797	-2.666624	6.748813	.064957	-.0169593	749.256	19.960	.02496	.00280
12	145	121	166	0	26.631516	7.214025	-2.697995	7.208959	.072339	-.0220334	756.102	9.517	0.00000	.00265
13	146	122	167	0	26.631516	7.214025	-2.697995	7.208959	.072339	-.0220334	756.102	5.180	.01332	.00265
14	147	0	168	0	-.002374	7.468179	-2.717351	7.462359	.079471	.0001889	757.389	10.154	.00100	.00261
15	148	123	169	0	1.818614	7.713632	-2.736625	7.707059	.077363	-.0265413	760.003	14.265	-.02434	.00254
17	149	124	171	0	4.539233	8.180709	-2.773164	8.172693	.080207	-.0256300	769.399	17.768	-.05557	.00253
18	150	125	172	0	.886661	8.619950	-2.808666	8.610491	.081275	-.0338574	779.552	16.239	-.04150	.00246
19	151	126	173	0	11.804725	9.035376	-2.842584	9.024524	.082256	-.0273713	789.480	33.772	-.09662	.00234
20	152	127	174	0	26.375532	10.519734	-2.960295	10.504262	.074702	-.0212307	818.475	64.246	-.09348	.00174
21	153	128	195	0	26.219176	12.953685	-3.120837	12.933059	.058366	-.0108232	850.280	91.917	-.04359	.00164
22	154	129	196	3	26.043196	16.750933	-3.305171	16.726023	.038777	-.0038877	871.233	102.602	0.00000	.00164

IDENT= NASA INLET CONFIGURATION NO. 8

STREAMTUBE CURVATURE PROGRAM

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
1	155	136	175	0	27.308860	0.000000	-2.011177	0.000000	0.000000	0.0000000	738.407	78.043	0.00000	0.00000
2	156	137	176	0	5.185541	1.812969	-2.021965	1.812772	.011893	.0019107	737.230	55.348	.02992	.00077
3	157	138	177	0	12.583725	2.564324	-2.032825	2.563980	.017246	.0029674	735.887	39.412	.07362	.00111
4	158	139	178	0	27.266789	3.627492	-2.055828	3.626793	.026010	.0046779	732.866	41.081	.13179	.00151
5	159	140	179	0	8.855264	4.443668	-2.080207	4.442517	.034293	.0051604	729.898	33.165	.16578	.00162
6	160	141	180	0	27.218643	5.131723	-2.106720	5.129984	.042835	.0053269	727.220	28.742	.17961	.00155
7	161	142	181	0	2.342615	5.737605	-2.135540	5.735115	.052398	.0025402	725.290	25.709	.15529	.00171
8	162	143	182	0	8.785391	6.284481	-2.166968	6.281038	.063353	-.0092036	726.459	17.893	.11186	.00225
9	163	0	183	0	-.002202	6.540224	-2.184258	6.536173	.071389	-.0000020	727.408	11.129	.04642	.00264
10	164	144	184	0	1.387811	6.785879	-2.202193	6.781165	.074776	-.0252199	729.733	10.646	.00846	.00283
11	165	0	185	0	-.001658	7.022509	-2.220942	7.017036	.083878	.0000700	731.928	10.205	.01916	.00312
12	166	145	186	0	27.090679	7.251025	-2.240231	7.244735	.084256	-.0298900	733.679	4.999	0.00000	.00329
13	167	146	187	0	27.090679	7.251025	-2.240231	7.244735	.084256	-.0298900	733.679	5.537	-.00561	.00329
14	168	147	188	0	.454382	7.507095	-2.262137	7.499860	.087686	-.0361574	739.970	10.762	-.02134	.00355
15	169	148	189	0	2.272698	7.753524	-2.284157	7.745290	.092142	-.0385983	747.145	10.194	-.01836	.00375
16	170	0	190	0	-.003732	7.991507	-2.307226	7.982122	.101107	.0005194	750.272	9.730	-.01900	.00400
17	171	149	191	0	4.984119	8.222049	-2.329983	8.211556	.096317	-.0469440	754.589	13.584	-.05396	.00414
18	172	150	192	0	1.324803	8.662066	-2.372270	8.649522	.097617	-.0406172	769.744	16.796	-.09552	.00426
19	173	151	193	0	12.236391	9.077367	-2.412628	9.062862	.096403	-.0382807	782.478	34.159	-.14154	.00408
20	174	152	194	3	26.791268	10.557571	-2.545866	10.537183	.083985	-.0234153	820.068	48.998	0.00000	.00227
1	175	155	198	0	27.759353	0.000000	-1.560685	0.000000	0.000000	0.0000000	735.464	78.944	0.00000	0.00000
2	176	156	199	0	5.636972	1.818280	-1.570563	1.817918	.010848	.0027074	733.818	56.052	.04199	.00041
3	177	157	200	0	13.036175	2.572000	-1.580437	2.571433	.015607	.0042581	731.907	40.035	.08435	.00047
4	178	158	201	0	27.721446	3.639041	-1.601311	3.638052	.023350	.0069876	727.578	41.886	.14653	.00034
5	179	159	202	0	9.312404	4.458970	-1.623313	4.457494	.030900	.0096757	722.653	34.043	.22089	-.00022
6	180	160	203	0	27.678445	5.150923	-1.647306	5.148854	.038709	.0126130	717.088	29.786	.21133	-.00121
7	181	161	204	0	2.804767	5.761518	-1.673989	5.758679	.048813	.0130049	711.419	27.019	.18402	-.00173
8	182	162	205	0	9.248405	6.314500	-1.704900	6.310624	.062957	.0110477	706.564	19.055	.16172	-.00063
9	183	163	206	0	.460936	6.573717	-1.722298	6.569193	.071294	.0004091	705.439	12.002	.12784	.00036
10	184	164	207	0	1.850162	6.822823	-1.741274	6.817530	.080792	-.0006782	705.415	11.538	.15484	.00154
11	185	165	208	0	.459401	7.062521	-1.761563	7.056344	.088336	-.0194054	707.055	11.058	.08339	.00263
12	186	166	209	0	27.549843	7.293568	-1.782963	7.286378	.097073	-.0258852	710.920	5.406	0.00000	.00365
13	187	167	210	0	27.549843	7.293568	-1.782963	7.286378	.097073	-.0258852	710.920	5.966	-.01201	.00365
14	188	168	211	0	.909535	7.552157	-1.809099	7.543626	.105286	-.0410168	717.207	11.592	-.08340	.00472
15	189	169	212	0	2.723109	7.800993	-1.836076	7.790973	.111824	-.0487740	725.282	10.912	-.10908	.00576
16	190	170	213	0	.442840	8.040773	-1.863145	8.029200	.114754	-.0616276	735.046	10.242	-.07240	.00669
17	191	171	214	0	5.426622	8.272075	-1.890030	8.258901	.118550	-.0533587	744.846	14.007	-.06246	.00733
18	192	172	215	0	1.757508	8.712183	-1.942067	8.695905	.118208	-.0546575	762.856	17.133	-.07615	.00748
19	193	173	216	0	12.661113	9.126540	-1.990262	9.107479	.114797	-.0483092	779.309	34.210	-.10577	.00698
20	194	174	217	0	27.194699	10.599740	-2.144028	10.572980	.093857	-.0255185	821.902	63.515	-.23471	.00347
21	195	153	218	0	27.005376	13.015895	-2.336168	12.982067	.066124	-.0088658	854.809	89.953	-.05236	.00253
22	196	154	240	0	26.817449	16.795523	-2.531547	16.757197	.041764	-.0038275	874.398	126.775	-.00892	.00202
23	197	130	429	3	26.645529	22.491539	-2.720678	22.450507	.024657	-.0011001	884.297	145.050	0.00000	.00142

IDENT= NASA INLET CONFIGURATION NO. 8

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
1	198	175	219	0	28.196148	0.000000	-1.123889	0.000000	0.000000	0.0000000	728.063	80.851	0.00000	0.00000
2	199	176	220	0	6.074890	1.822934	-1.132668	1.822399	.009606	.0029230	726.396	57.411	.04409	-.00021
3	200	177	221	0	13.475107	2.578644	-1.141552	2.577852	.013598	.0048509	724.283	41.048	.07710	-.00061
4	201	178	222	0	28.164037	3.648912	-1.158823	3.647662	.020009	.0080307	719.402	43.018	.12777	-.00159
5	202	179	223	0	9.757578	4.471973	-1.178321	4.470206	.026054	.0119809	713.600	35.084	.25301	-.00316
6	203	180	224	0	28.128491	5.167054	-1.197543	5.164779	.031609	.0189051	706.155	30.939	.24537	-.00611
7	204	181	225	0	3.259457	5.781926	-1.219753	5.778933	.038965	.0305207	695.507	28.538	.20653	-.00889
8	205	182	226	0	9.709259	6.341665	-1.244843	6.337688	.052910	.0325711	683.026	20.506	-.00961	-.00860
9	206	183	227	0	.923615	6.605964	-1.260734	6.601276	.065641	.0242823	677.812	13.183	.15468	-.00623
10	207	184	228	0	2.313539	6.860500	-1.279413	6.854974	.080980	-.0003094	675.633	12.768	.04386	-.00324
11	208	185	229	0	.921658	7.105858	-1.301305	7.099274	.097842	-.0216415	677.444	12.250	-.00594	.00007
12	209	186	230	0	28.009005	7.342260	-1.326314	7.334312	.113688	-.0465781	682.871	5.982	0.00000	.00345
13	210	187	231	0	28.009005	7.342260	-1.326314	7.334312	.113688	-.0465781	682.871	6.543	-.06410	.00345
14	211	188	232	0	1.363389	7.606158	-1.358315	7.596227	.128630	-.0619039	692.747	12.624	-.03655	.00721
15	212	189	233	0	3.170646	7.858861	-1.392026	7.846615	.139439	-.0747113	704.866	11.706	.01710	.01026
16	213	190	234	0	.883272	8.100987	-1.426438	8.086209	.146242	-.0807863	718.319	10.820	.00814	.01224
17	214	191	235	0	5.859926	8.333434	-1.460533	8.316084	.148518	-.0853503	732.423	14.465	.04191	.01330
18	215	192	236	0	2.178438	8.772936	-1.524755	8.750870	.144979	-.0726294	758.479	17.362	-.06073	.01260
19	216	193	237	0	13.071848	9.184880	-1.582762	9.158856	.136741	-.0585461	779.192	33.763	-.12620	.01088
20	217	194	238	0	27.583324	10.647014	-1.757305	10.611367	.104140	-.0273881	828.183	62.180	-.33071	.00464
21	218	195	239	3	27.376694	13.050840	-1.965702	13.007210	.069407	-.0088873	858.067	68.712	0.00000	.00297

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
1	219	198	257	0	28.609477	0.000000	-.710560	0.000000	0.000000	0.0000000	724.929	81.755	0.00000	0.00000
2	220	199	258	0	6.489309	1.826909	-.718265	1.826130	.008412	.0027905	723.224	58.050	.04764	-.00101
3	221	200	259	0	13.890788	2.584198	-.725904	2.583092	.011660	.0043229	721.296	41.488	.05159	-.00197
4	222	201	241	0	28.582044	3.656929	-.740887	3.655304	.016516	.0086298	716.528	43.503	.12891	-.00401
5	223	202	242	0	10.179864	4.482142	-.756151	4.480057	.020398	.0148826	709.752	35.562	.36549	-.00678
6	224	203	243	0	28.555276	5.178830	-.770918	5.176401	.022544	.0234349	700.612	31.514	.40090	-.01265
7	225	204	244	0	3.694408	5.795260	-.785021	5.792556	.022730	.0438920	686.896	29.543	.36247	-.02032
8	226	205	245	0	10.156491	6.359558	-.798013	6.356231	.025608	.0908635	661.918	21.855	-.34801	-.02638
9	227	206	246	0	1.378285	6.630384	-.806761	6.626127	.038059	.0981020	645.040	14.838	.12791	-.02342
10	228	207	247	0	2.774146	6.894732	-.820093	6.889251	.061216	.0870901	628.906	15.020	.14135	-.01689
11	229	208	248	0	1.384124	7.152400	-.841149	7.145444	.099257	.0157545	620.129	14.841	.38596	-.00678
12	230	209	249	0	28.468168	7.400734	-.870782	7.391843	.138814	-.0628261	623.640	7.308	0.00000	.00387
13	231	210	250	0	28.468168	7.400734	-.870782	7.391843	.138814	-.0628261	623.640	7.854	.01068	.00387
14	232	211	251	0	1.812929	7.675713	-.913842	7.663218	.177708	-.1566848	643.737	14.800	-.15900	.01478
15	233	212	252	0	3.606786	7.934963	-.961768	7.917613	.195655	-.1837695	673.587	13.003	-.21148	.02157
16	234	213	253	0	1.306375	8.179653	-1.009418	8.157380	.197808	-.1640948	703.368	11.400	-.05954	.02373
17	235	214	254	0	6.271981	8.411932	-1.054374	8.385318	.191951	-.1256391	727.292	14.549	.06750	.02327
18	236	215	255	0	2.573526	8.847786	-1.134780	8.814099	.177947	-.0944495	762.728	17.035	-.01887	.01950
19	237	216	256	0	13.455276	9.254430	-1.203566	9.215593	.160852	-.0671264	788.044	32.534	-.14326	.01517
20	238	217	276	0	27.942896	10.700308	-1.399854	10.650352	.112537	-.0182608	834.907	60.307	-.39105	.00591
21	239	218	277	0	27.731210	13.089744	-1.612079	13.032355	.072570	-.0089625	861.010	86.877	-.06300	.00353
22	240	196	428	3	27.518310	16.849558	-1.831333	16.787311	.044056	-.0026646	877.231	98.908	0.00000	.00235

IDENT= NASA INLET CONFIGURATION NO. 8

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
4	241	222	260	3	28.778917	0.000000	-.544038	3.658387	.014839	.0078958	716.528	37.840	0.00000	-.00507
5	242	223	261	0	10.378669	.825757	-.557381	4.483809	.017300	.0163415	709.469	35.617	.44143	-.00872
6	243	224	262	0	28.755572	1.522572	-.570662	5.180433	.017687	.0246846	699.527	31.550	.50605	-.01607
7	244	225	263	0	3.900906	2.138233	-.578558	5.796304	.013797	.0386840	686.980	29.529	.44762	-.02689
8	245	226	264	0	10.369663	2.701288	-.584868	6.359451	.003929	.1107988	660.980	22.029	-.32891	-.03964
9	246	227	265	0	1.599447	2.973584	-.585673	6.631220	.002501	.2380729	630.701	15.627	-.72578	-.04005
10	247	228	266	0	3.002238	3.245548	-.592312	6.901145	.044560	.0535171	605.275	16.406	-.32645	-.03182
11	248	229	267	0	1.615053	3.513511	-.611281	7.167537	.090703	.0588637	596.035	16.459	-.66305	-.01516
12	249	230	268	0	28.697749	3.774404	-.643786	7.426149	.165241	-.1680780	601.584	8.139	0.00000	.00528
13	250	231	269	0	28.697749	3.774404	-.643786	7.426149	.165241	-.1680780	601.584	8.471	-.02628	.00528
14	251	232	270	0	2.032272	4.060142	-.698756	7.706147	.218443	-.2148446	636.920	15.610	.83810	.02406
15	252	233	271	0	3.815705	4.323276	-.757655	7.962126	.233171	-.1698856	670.797	13.280	1.13550	.03242
16	253	234	272	0	1.507367	4.567571	-.812994	8.199973	.227592	-.1211617	694.685	11.583	.67787	.03268
17	254	235	273	0	6.466229	4.798007	-.864189	8.424827	.218395	-.1469500	716.755	14.793	.02475	.02896
18	255	236	274	0	2.758066	5.230050	-.953455	8.848394	.196122	-.1018187	756.891	17.246	-.06520	.02290
19	256	237	275	3	13.633893	5.632632	-1.027427	9.245248	.172481	-.0599123	781.933	15.171	0.00000	.01694
1	257	219	289	0	29.000026	0.000000	-.320011	0.000000	0.000000	0.0000000	619.321	108.425	0.00000	0.00000
2	258	220	290	0	6.880865	1.830197	-.326722	1.829210	.007319	.0028293	617.712	76.928	.10231	-.00183
3	259	221	291	0	14.283723	2.588720	-.332992	2.587350	.010034	.0039797	616.123	54.826	.09763	-.00330
4	260	241	292	0	28.975737	3.663048	-.347238	3.661158	.013351	.0068859	612.718	57.246	.21264	-.00636
5	261	242	293	0	10.579471	4.488953	-.356603	4.486947	.014114	.0123231	607.976	46.430	.48597	-.01084
6	262	243	294	0	28.957756	5.185493	-.368502	5.183504	.012967	.0175425	601.630	40.570	.50946	-.01943
7	263	244	278	0	4.108255	5.799781	-.371219	5.798392	.007208	.0164443	595.834	36.932	.52816	-.03332
8	264	245	279	0	10.584216	6.357335	-.370324	6.357846	-.016875	.0623935	584.952	26.584	.45229	-.05598
9	265	246	280	0	1.824500	6.623011	-.360731	6.625406	-.053477	.2316819	563.376	19.172	-6.46216	-.06915
10	266	247	281	0	3.240537	6.911493	-.354155	6.908889	.013030	.2282595	523.106	21.145	.22821	-.05292
11	267	248	282	0	1.856608	7.196669	-.370785	7.190091	.106890	-.1987511	520.810	21.084	-5.37152	-.02877
12	268	249	283	0	28.927324	7.480236	-.418179	7.468557	.207593	-.1999419	556.624	10.292	0.00000	.00785
13	269	250	284	0	28.927324	7.480236	-.418179	7.468557	.207593	-.1999419	556.624	9.754	.06185	.00785
14	270	251	285	0	2.248128	7.779575	-.489428	7.758689	.278039	-.3393326	607.265	17.344	2.35002	.03646
15	271	252	286	0	4.018685	8.044331	-.561128	8.012833	.274801	-.2501061	658.127	13.763	1.00870	.04508
16	272	253	287	0	1.702108	8.286240	-.623905	8.246510	.258784	-.2235485	696.445	11.456	-.48345	.04190
17	273	254	288	0	6.653386	8.515136	-.682120	8.468130	.250546	-.2048647	731.808	14.030	.20897	.03340
18	274	255	424	0	2.933414	8.940846	-.781778	8.884076	.213205	-.0863809	777.233	16.090	-.01975	.02568
19	275	256	425	0	13.804367	9.338020	-.859629	9.275330	.182033	-.0509722	798.376	31.009	-.38244	.01865
20	276	238	426	0	28.278205	10.763191	-1.066786	10.689048	.119157	-.0235867	840.589	58.394	-.63320	.00707
21	277	239	427	3	28.046799	13.138163	-1.297351	13.055650	.075023	-.0059605	864.595	66.046	0.00000	.00392
7	278	263	295	3	4.289260	0.000000	-.190217	5.799505	.005603	.0014940	595.834	34.713	0.00000	-.03608
8	279	264	296	0	10.769013	.552240	-.185570	6.353887	-.023022	-.0237491	660.557	23.097	1.89421	-.06476
9	280	265	297	0	2.018283	.801646	-.167657	6.609639	-.124822	.6555948	613.613	16.962	-14.69323	-.09826
10	281	266	298	0	3.449034	1.106274	-.145677	6.906980	-.025254	.0832793	553.425	21.857	5.29444	-.07200
11	282	267	299	0	2.084595	1.412086	-.143854	7.211130	.031986	.9290176	467.151	26.912	2.81890	-.05832
12	283	268	300	0	29.156890	1.732497	-.195699	7.524774	.304808	-.6453505	417.373	14.948	0.00000	.00665
13	284	269	419	0	29.156890	1.732497	-.195699	7.524774	.304808	-.6453505	417.373	13.257	4.71415	.00665
14	285	270	420	0	2.434646	2.049711	-.313116	7.819123	.406406	-1.0581965	556.276	20.658	-4.87630	.04909
15	286	271	421	0	4.176911	2.309815	-.410338	8.060590	.358059	-.9142916	725.757	11.817	-5.17214	.05319
16	287	272	422	0	1.845171	2.546685	-.486329	8.285715	.301192	-.4047628	850.287	7.412	-2.46961	.04614
17	288	273	423	3	6.789100	2.773581	-.551135	8.503637	.277986	-.1725316	903.552	5.256	0.00000	.03519

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
1	289	257	308	0	29.376119	0.000000	.056082	0.000000	0.000000	0.0000000	723.959	79.147	0.00000	0.00000
2	290	258	309	0	7.257801	1.831767	.050206	1.831779	.006379	.0017856	722.725	56.222	-.02533	-.00224
3	291	259	310	0	14.661207	2.590874	.044475	2.590875	.008753	.0023884	721.585	40.232	-.03218	-.00392
4	292	260	311	0	29.355922	3.665825	.032920	3.665777	.011052	.0052393	718.490	42.272	-.02911	-.00743
5	293	261	312	0	10.961356	4.491691	.025253	4.491598	.010916	.0034898	715.692	34.734	-.07397	-.01267
6	294	262	301	0	29.340900	5.187787	.014620	5.187569	.009880	-.0039687	715.602	31.099	-.12372	-.02178
7	295	278	302	0	4.493750	5.801014	.014269	5.800754	.007051	-.0138248	716.116	29.878	.30725	-.03696
8	296	279	303	0	10.960541	6.351441	.005931	6.350910	.002688	-.2561587	742.723	23.451	1.06462	-.06646
9	297	280	304	0	2.193204	6.590827	.005925	6.591471	.098084	-3.3020497	1117.375	18.673	10.18867	-.11169
10	298	281	305	3	3.592299	6.903625	-.002476	6.902665	-.034143	.0504883	1901.776	24.227	8.27671	-.41484
11	299	282	306	3	2.256443	7.206832	.027710	7.203600	-.108110	.6073819	1609.738	32.453	0.00000	-.06274
12	300	283	307	1	29.386458	7.612587	.017342	7.609729	.160635	2.8308127	0.000	151.123	0.00000	0.00000
6	301	294	313	3	29.498245	0.000000	.171957	5.189169	.010434	-.0030704	704.793	29.707	0.00000	-.02218
7	302	295	314	0	4.645308	.613015	.165822	5.802012	.009532	-.0142675	688.318	30.125	.30321	-.03712
8	303	296	315	0	11.111685	1.163391	.157057	6.353101	.021549	-.0601830	655.242	22.762	-.10103	-.06486
9	304	297	316	0	2.326447	1.416101	.137503	6.612856	.122692	.9190332	624.856	16.162	3.44980	-.09360
10	305	298	317	0	3.724138	1.711834	.129272	6.897766	-.039846	.0320558	577.538	18.459	3.19947	-.04790
11	306	299	318	0	2.384783	2.002957	.154766	7.185659	-.165719	.2849564	488.879	18.512	23.94773	-.05549
12	307	300	319	0	29.662782	2.265878	.229688	7.437040	-.412003	-1.3632544	507.156	16.375	0.00000	0.00000
1	308	289	320	0	29.812704	0.000000	.492667	0.000000	0.000000	0.0000000	702.085	87.626	0.00000	0.00000
2	309	290	321	0	7.694886	1.833970	.487283	1.834419	.005757	.0011020	700.782	62.177	-.01346	-.00275
3	310	291	322	0	15.097455	2.593894	.480709	2.594486	.007853	.0016733	698.868	44.413	.01397	-.00468
4	311	292	323	0	29.799289	3.669588	.476262	3.670336	.009871	.0008736	694.647	46.517	-.00161	-.00856
5	312	293	324	0	11.399242	4.495527	.463115	4.496200	.010425	-.0004723	689.032	37.973	.05191	-.01410
6	313	301	325	0	29.785788	5.191570	.459483	5.192274	.011094	-.0017501	681.119	33.517	.09309	-.02240
7	314	302	326	0	4.928003	5.804445	.448500	5.805103	.011810	-.0040433	672.035	30.755	.03332	-.03409
8	315	303	327	0	11.396380	6.358987	.441674	6.359787	.019590	.0462839	664.180	21.778	.63393	-.04876
9	316	304	328	0	2.627096	6.624478	.437597	6.623952	-.002950	-.0061848	666.114	13.321	.59750	-.04927
10	317	305	329	0	4.036712	6.887906	.441603	6.885374	-.034339	-.0603974	687.751	11.402	-.74984	-.03743
11	318	306	330	0	2.698281	7.138935	.463855	7.133283	-.127304	-.4990495	785.264	8.143	-3.34650	-.01894
12	319	307	331	0	29.939047	7.374665	.495657	7.366548	-.139866	-.6615059	940.533	4.076	0.00000	0.00000
1	320	308	332	0	30.423886	0.000000	1.103849	0.000000	0.000000	0.0000000	699.982	88.306	0.00000	0.00000
2	321	309	333	0	8.306581	1.837571	1.098968	1.837776	.005288	.0004436	698.752	62.623	-.00519	-.00323
3	322	310	334	0	15.710266	2.598809	1.093502	2.599077	.007281	.0002681	697.651	44.576	.00301	-.00520
4	323	311	335	0	30.410111	3.675886	1.087057	3.676221	.009431	.0005005	694.998	46.436	.01024	-.00878
5	324	312	336	0	12.012246	4.502365	1.076085	4.502679	.010715	-.0005215	692.716	37.423	-.02930	-.01283
6	325	313	337	0	30.396818	5.199013	1.070473	5.199308	.011817	-.0007392	692.007	32.244	.00171	-.01722
7	326	314	338	0	5.540311	5.812574	1.060760	5.812789	.012807	.0004086	694.266	28.357	.03322	-.02059
8	327	315	339	0	12.010729	6.367186	1.055975	6.367135	.010916	-.0165412	706.284	19.243	.11113	-.01996
9	328	316	340	0	3.242921	6.627715	1.053410	6.627528	.009619	-.0153524	717.365	11.484	.04941	-.01623
10	329	317	341	0	4.647655	6.876175	1.052433	6.875911	.003752	-.0642401	727.288	10.805	.69559	-.01282
11	330	318	342	0	3.284967	7.115991	1.049699	7.115674	.016644	.0143145	717.392	10.467	1.83720	-.00764
12	331	319	343	0	30.491575	7.346882	1.047313	7.346590	.003791	-.0549163	706.635	10.522	0.00000	0.00000
1	332	320	344	0	30.989094	0.000000	1.669057	0.000000	0.000000	0.0000000	691.736	90.456	0.00000	0.00000
2	333	321	345	0	8.871934	1.840570	1.664313	1.840718	.005161	.0000114	691.108	64.058	.00042	-.00320
3	334	322	346	0	16.276418	2.602975	1.659640	2.603170	.007199	.0000149	690.457	45.433	.00941	-.00490
4	335	323	347	0	30.973089	3.681301	1.650009	3.681517	.009503	-.0006970	689.560	47.113	.00259	-.00762
5	336	324	348	0	12.578317	4.508651	1.642122	4.508866	.011213	-.0011874	689.581	37.677	.01000	-.00997
6	337	325	349	0	30.959347	5.205959	1.632961	5.206132	.012551	-.0018093	691.125	32.194	.01898	-.01152
7	338	326	350	0	6.105642	5.820093	1.626042	5.820200	.013831	-.0038512	695.840	28.234	.01683	-.01129
8	339	327	351	0	12.572194	6.375045	1.617384	6.375071	.015925	-.0014641	703.823	19.317	-.03042	-.00833
9	340	328	352	0	3.803033	6.634902	1.613472	6.634880	.015839	-.0068674	708.602	11.809	-.05938	-.00595
10	341	329	353	0	5.204202	6.884395	1.608910	6.884327	.019947	.0060541	714.493	11.133	-.34721	-.00339
11	342	330	354	0	3.839994	7.124375	1.604660	7.124256	.017909	-.0219255	725.458	10.461	-.57239	-.00118
12	343	331	355	0	31.044107	7.355494	1.599769	7.355305	.024563	-.0202585	735.291	9.987	0.00000	0.00000

IDENT= NASA INLET CONFIGURATION NO. 8

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
1	344	332	356	0	31.545352	0.000000	2.225315	0.000000	0.000000	0.0000000	689.531	91.122	0.00000	0.00000
2	345	333	357	0	9.428133	1.843532	2.220505	1.843602	.005238	-.0002840	689.291	64.463	.00303	-.00286
3	346	334	358	0	16.832180	2.607106	2.215387	2.607189	.007303	-.0003849	689.237	45.586	.00095	-.00415
4	347	335	359	0	31.530396	3.686842	2.207290	3.686921	.009889	-.0006924	689.524	47.139	.00217	-.00597
5	348	336	360	0	13.133761	4.515214	2.197529	4.515251	.011732	-.0006909	690.525	37.571	.01259	-.00705
6	349	337	361	0	31.515840	5.213374	2.189406	5.213362	.013368	-.0011273	692.782	32.081	-.01636	-.00712
7	350	338	362	0	6.660256	5.828369	2.180597	5.828286	.015009	-.0004018	696.078	28.318	-.00378	-.00606
8	351	339	363	0	13.127003	6.384248	2.172120	6.384091	.016520	-.0006825	699.108	19.594	-.00044	-.00391
9	352	340	0	0	4.357306	6.644566	2.167664	6.644364	.017753	-.0000386	699.740	12.218	.01182	-.00277
10	353	341	364	0	5.758676	6.895081	2.163284	6.894838	.018659	-.0014101	699.048	11.787	.01143	-.00168
11	354	342	0	0	4.393452	7.136748	2.157983	7.136427	.024052	-.0001232	698.475	11.414	.02668	-.00085
12	355	343	365	0	31.596631	7.370605	2.152096	7.370204	.026180	.0144078	697.511	11.254	0.00000	0.00000
1	356	344	366	0	32.096697	0.000000	2.776660	0.000000	0.000000	0.0000000	686.260	92.051	0.00000	0.00000
2	357	345	367	0	9.979288	1.846493	2.771652	1.846542	.005449	-.0004809	686.432	65.058	.00319	-.00237
3	358	346	368	0	17.383129	2.611232	2.766321	2.611283	.007582	-.0006261	686.740	45.920	.00028	-.00329
4	359	347	369	0	32.081224	3.692442	2.758091	3.692479	.010302	-.0008073	687.638	47.417	.00249	-.00441
5	360	348	370	0	13.683936	4.521841	2.747665	4.521823	.012184	-.0009516	689.056	37.765	-.00381	-.00476
6	361	349	371	0	32.066162	5.220921	2.739677	5.220854	.013799	-.0004417	690.758	32.313	.00439	-.00441
7	362	350	372	0	7.209763	5.836709	2.730042	5.836567	.015084	.0001276	692.329	28.670	.00103	-.00345
8	363	351	373	0	13.676925	6.393385	2.721966	6.393179	.016354	.0012907	693.383	26.051	-.02470	-.00214
10	364	353	374	0	6.308372	6.905299	2.712886	6.905011	.017793	.0046460	693.510	24.085	-.02602	-.00096
12	365	355	375	0	32.149159	7.381916	2.704506	7.381555	.017394	-.0001339	693.305	23.236	0.00000	0.00000
1	366	356	376	0	32.650702	0.000000	3.330665	0.000000	0.000000	0.0000000	683.130	92.956	0.00000	0.00000
2	367	357	377	0	10.533006	1.849613	3.325362	1.849641	.005756	-.0006305	683.619	65.651	.00201	-.00185
3	368	358	378	0	17.936731	2.615565	3.319906	2.615586	.007981	-.0008173	684.182	46.277	-.00176	-.00246
4	369	359	379	0	32.633695	3.698321	3.310530	3.698310	.010839	-.0011379	685.494	47.750	.00081	-.00310
5	370	360	380	0	14.236479	4.528777	3.300165	4.528706	.012739	-.0010621	686.916	38.031	-.00154	-.00313
6	371	361	381	0	32.617859	5.228664	3.291321	5.228535	.014048	-.0004591	688.144	32.584	.00137	-.00274
7	372	362	382	0	7.761772	5.845128	3.281987	5.844926	.015300	-.0009109	689.210	28.959	-.00494	-.00207
8	373	363	383	0	14.228494	6.402345	3.273463	6.402076	.016039	-.0001575	689.926	26.339	-.00414	-.00130
10	374	364	0	0	6.860611	6.914698	3.265046	6.914359	.016493	.0000197	690.073	24.345	-.00174	-.00060
12	375	365	384	0	32.701687	7.391595	3.256950	7.391185	.017467	-.0001318	690.069	23.472	0.00000	0.00000
1	376	366	385	0	33.764232	0.000000	4.444195	0.000000	0.000000	0.0000000	676.148	95.010	0.00000	0.00000
2	377	367	386	0	11.645645	1.856527	4.437979	1.856529	.006711	-.0010866	676.948	67.053	.00159	-.00100
3	378	368	387	0	19.048495	2.625156	4.431629	2.625136	.009357	-.0016576	677.846	47.189	-.00071	-.00123
4	379	369	388	0	33.743585	3.711317	4.420345	3.711240	.012642	-.0021120	679.642	48.638	-.00041	-.00139
5	380	370	389	0	15.344927	4.543952	4.408510	4.543791	.014762	-.0025869	681.351	38.685	-.00025	-.00128
6	381	371	390	0	33.724555	5.245183	4.397895	5.244940	.016124	-.0032927	683.140	33.111	-.00140	-.00103
7	382	372	0	0	8.867809	5.862544	4.387890	5.862221	.015806	-.0000013	684.000	29.435	-.00106	-.00072
8	383	373	391	0	15.334070	6.420530	4.378892	6.420132	.016830	-.0012699	684.321	38.709	.00075	-.00048
12	384	375	392	0	33.806743	7.411112	4.361836	7.410565	.017610	-.0001276	685.219	49.432	0.00000	0.00000
1	385	376	393	0	36.035875	0.000000	6.715838	0.000000	0.000000	0.0000000	655.970	101.162	0.00000	0.00000
2	386	377	394	0	13.913677	1.875643	6.705929	1.875597	.010567	-.0023140	657.669	71.264	.00025	-.00016
3	387	378	395	0	21.313145	2.651600	6.696124	2.651488	.014319	-.0027248	659.026	50.007	-.00045	-.00017
4	388	379	396	0	36.001379	3.747420	6.677848	3.747146	.020043	-.0044436	661.696	51.420	-.00083	-.00013
5	389	380	397	0	17.595780	4.586547	6.658958	4.586054	.023898	-.0055309	664.558	40.755	-.00128	-.00009
6	390	381	398	0	35.968559	5.292501	6.641400	5.291785	.026688	-.0061213	667.269	49.106	-.00137	-.00005
8	391	383	399	0	17.561382	6.471988	6.605603	6.470715	.033074	-.0133224	675.212	55.566	-.00120	-.00002
12	392	384	400	0	36.016856	7.459723	6.571413	7.457852	.036122	-.0140287	684.688	49.383	0.00000	0.00000

IDENT= NASA INLET CONFIGURATION NO. 8

STREAMTUBE CURVATURE PROGRAM

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
1	393	385	401	0	38.327131	0.000000	9.007094	0.000000	0.000000	0.0000000	629.787	109.828	0.00000	0.00000
2	394	386	0	0	16.202433	1.903900	8.994511	1.903827	.013219	-.0000014	628.376	77.818	.00065	.00003
3	395	387	402	0	23.598492	2.692728	8.981096	2.692525	.022121	-.0041036	629.331	54.805	-.00083	.00005
4	396	388	403	0	38.273615	3.805917	8.949329	3.805243	.031578	-.0057082	632.888	56.253	-.00077	.00007
5	397	389	404	0	19.858614	4.657381	8.920683	4.656210	.038972	-.0077904	636.514	44.424	-.00068	.00007
6	398	390	405	0	38.217818	5.372772	8.889235	5.370900	.045285	-.0104139	640.862	53.604	-.00154	.00006
8	399	391	0	0	19.794386	6.569765	8.836521	6.566726	.047983	-.0000088	643.876	61.342	.00412	-.00001
12	400	392	406	0	38.226968	7.577077	8.778453	7.572322	.067358	-.0132064	647.076	55.588	0.00000	0.00000
1	401	393	407	0	40.636214	0.000000	11.316177	0.000000	0.000000	0.0000000	591.114	175.075	0.00000	0.00000
3	402	395	408	0	25.894614	2.752503	11.276441	2.752087	.028873	-.0017752	592.412	123.418	-.00028	.00004
4	403	396	409	0	40.562426	3.891078	11.236563	3.889941	.041350	-.0028277	593.954	63.515	-.00002	.00005
5	404	397	410	0	22.136410	4.763490	11.196033	4.761396	.051765	-.0034372	595.585	50.545	.00005	.00004
6	405	398	411	0	40.486542	5.497953	11.154554	5.494672	.061357	-.0037456	597.134	93.223	.00009	.00003
12	406	400	412	0	40.437081	7.759902	10.981365	7.749859	.091920	-.0087311	604.921	138.967	0.00000	0.00000
1	407	401	413	0	42.873947	0.000000	13.553910	0.000000	0.000000	0.0000000	554.618	196.578	0.00000	0.00000
3	408	402	414	0	28.129095	2.820295	13.509895	2.819816	.031217	-.0003227	554.999	138.902	-.00006	.00002
4	409	403	415	0	42.793780	3.988332	13.465804	3.987001	.044681	-.0001580	555.162	71.855	.00010	.00001
5	410	404	416	0	24.364446	4.884662	13.420792	4.882188	.055366	.0002038	555.157	57.510	.00013	.00001
6	411	405	417	0	42.712251	5.640532	13.375726	5.636703	.064690	.0007503	554.939	107.825	.00054	.00001
12	412	406	418	0	42.647193	7.979501	13.180743	7.967368	.102237	-.0006049	554.341	163.143	0.00000	0.00000
1	413	407	0	0	47.255784	0.000000	17.935747	0.000000	0.000000	0.0000000	491.810	241.913	0.00000	0.00000
3	414	408	0	0	32.509922	2.959119	17.888522	2.958609	.031922	.0000000	491.810	171.068	.00000	.00000
4	415	409	0	0	47.173456	4.185064	17.841064	4.183627	.045025	.0000000	491.810	88.568	-.00000	.00000
5	416	410	0	0	28.744788	5.125872	17.794493	5.123277	.054917	-.0000000	491.810	70.877	-.00001	.00000
6	417	411	0	0	47.092550	5.919075	17.747170	5.915066	.063043	-.0000000	491.865	133.698	-.00000	.00000
12	418	412	0	0	47.067418	8.380877	17.582446	8.371343	.070882	.0112676	486.790	203.890	0.00000	0.00000
13	419	284	435	1	29.386458	0.000000	.017342	7.609729	.607234	-2.7079624	0.000	56.463	0.00000	0.00000
14	420	285	436	3	2.599326	.340894	-.167190	7.895218	.537849	-.4880602	538.420	17.747	0.00000	.04080
15	421	286	437	0	4.306237	.593608	-.291640	8.111872	.442845	-.3458653	684.357	12.763	-3.93952	.04981
16	422	287	438	0	1.962829	.823645	-.374923	8.323532	.355093	-.4486833	726.804	10.117	-3.63662	.04552
17	423	288	439	0	6.904767	1.047329	-.440210	8.536419	.295537	-.1193973	746.580	13.008	.42951	.03590
18	424	274	440	0	3.148120	1.465763	-.572298	8.931158	.226625	-.0284836	792.486	15.125	-.78092	.02712
19	425	275	441	0	14.025215	1.858464	-.642619	9.316327	.189894	-.0141452	812.597	29.658	-.33367	.01973
20	426	276	442	0	28.478763	3.274401	-.867704	10.713337	.123277	-.0134096	846.205	56.744	-.36402	.00758
21	427	277	443	0	28.255471	5.643205	-1.089275	13.071406	.076051	-.0037530	867.057	84.153	-.13443	.00412
22	428	240	471	0	28.031207	9.389208	-1.318948	16.810212	.045198	-.0017872	879.463	122.762	-.04781	.00252
23	429	197	491	0	27.860767	15.063494	-1.505827	22.481192	.025777	-.0007429	886.704	176.795	-.01760	.00157
24	430	131	511	0	27.726854	23.409034	-1.669966	30.825027	.014349	-.0002534	890.287	184.615	-.00530	.00087
25	431	132	512	0	27.675045	29.928556	-1.748393	37.344056	.010208	-.0001256	891.422	148.519	-.00199	.00059
26	432	133	513	0	27.646819	35.466395	-1.798476	42.881660	.008025	-.0000787	891.976	182.569	-.00124	.00045
27	433	134	514	0	27.618668	44.807354	-1.861587	52.222395	.005733	-.0000381	892.499	211.242	-.00082	.00032
28	434	135	515	0	27.603301	52.713228	-1.902274	60.128160	.004565	-.0000193	892.737	3976.968	-.05094	.00027
13	435	419	444	0	29.602659	0.000000	.116605	7.792927	.424991	1.3320616	712.864	10.654	0.00000	0.00000
14	436	420	445	0	2.800414	.237666	.003223	8.001965	.532495	.1889289	733.483	8.957	4.63988	.02127
15	437	421	446	0	4.506528	.470004	-.111788	8.200053	.435855	.1773190	833.521	7.085	-5.31936	.04015
16	438	422	447	0	2.153769	.684148	-.197262	8.393541	.374373	.1770116	823.315	6.705	-1.29945	.04035
17	439	423	448	0	7.087449	.895522	-.265707	8.590485	.299507	.0678568	817.670	9.970	-.76455	.03564
18	440	424	449	0	3.354668	1.299750	-.371068	8.977731	.226166	.0306428	828.739	12.671	-.67553	.02738
19	441	425	450	0	14.222483	1.685106	-.448906	9.353611	.189325	.0166911	836.329	27.261	-.42671	.02035
20	442	426	451	0	28.684322	3.089656	-.663726	10.738780	.124399	.0003094	854.355	54.361	-.23858	.00812
21	443	427	452	3	28.445096	5.450770	-.900203	13.085876	.076685	-.0029337	868.862	64.363	0.00000	.00423

IDENT= NASA INLET CONFIGURATION NO. 8

STREAMTUBE CURVATURE PROGRAM

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
13	444	435	453	0	29.818876	0.000000	.319146	7.864666	.285018	.3384961	1717.757	-65.159	0.00000	0.00000
14	445	436	454	0	3.056048	.259528	.234493	8.107362	.385278	.2736775	1371.033	-19.076	-4.16235	.01355
15	446	437	455	0	4.801868	.466296	.163788	8.303925	.307790	.3131697	1158.896	-3.492	-1.92425	.02321
16	447	438	456	0	2.479297	.662460	.111386	8.495884	.240672	.6343733	1052.367	.675	-1.45451	.02676
17	448	439	457	0	7.436766	.854714	.070747	8.684004	.226177	.3503125	963.430	4.858	-.85794	.02606
18	449	440	458	0	3.726607	1.235496	-.007723	9.057154	.198977	.1154874	896.345	8.610	.01804	.02137
19	450	441	459	0	14.601070	1.607446	-.076737	9.423013	.177591	.0452903	875.195	23.765	-.18653	.01773
20	451	442	460	0	29.074853	2.985527	-.276195	10.787088	.123309	.0052764	860.354	51.249	-.00298	.00844
21	452	443	461	3	28.835673	5.326078	-.510788	13.115978	.077501	-.0012463	874.067	62.542	0.00000	.00436
13	453	444	462	0	30.035089	0.000000	.528088	7.920237	.241786	.1430406	1160.790	-2.619	0.00000	0.00000
14	454	445	463	0	3.316029	.218318	.491579	8.135824	.091351	-1.3413787	977.499	2.184	1.12474	.00332
15	455	446	464	0	5.113969	.431767	.471992	8.348069	.121164	-.6907244	905.833	3.924	1.04795	.00792
16	456	447	465	0	2.813752	.637238	.441203	8.550876	.142124	-.1914246	957.598	3.650	-.32325	.01226
17	457	448	466	0	7.780323	.834765	.408698	8.745511	.156369	.0023416	950.404	5.351	-.12547	.01399
18	458	449	467	0	4.087703	1.216093	.347519	9.121822	.164448	.0667734	920.290	7.825	-.11853	.01430
19	459	450	468	0	14.970025	1.584417	.286967	9.485010	.159884	.0486489	900.123	21.498	-.14077	.01347
20	460	451	469	0	29.455452	2.946493	.101577	10.833392	.120281	.0100295	871.049	48.359	.02778	.00785
21	461	452	470	3	29.219185	5.271676	-.128431	13.145722	.077662	.0004106	878.625	60.944	0.00000	.00428
13	462	453	472	0	30.251302	0.000000	.738653	7.969259	.215920	.1215897	1050.425	.940	0.00000	0.00000
14	463	454	473	0	3.520979	.210370	.692625	8.174529	.225497	.2345776	997.761	2.244	.09973	.00225
15	464	455	474	0	5.294255	.418372	.649702	8.378078	.187858	.0467116	964.212	2.986	.09718	.00487
16	465	456	475	0	2.989037	.621454	.614369	8.578033	.164302	-.0460827	962.557	3.191	.00713	.00742
17	466	457	476	0	7.956328	.819112	.582536	8.773045	.158710	-.0271301	956.126	5.014	.10542	.00912
18	467	458	477	0	4.264706	1.200967	.522261	9.150019	.156937	.0215934	937.026	7.122	-.00027	.01080
19	468	459	478	0	15.150537	1.568528	.465292	9.513020	.152024	.0387983	919.062	19.469	-.04373	.01106
20	469	460	479	0	29.638884	2.923861	.283703	10.855245	.118602	.0088553	887.640	45.263	.00333	.00734
21	470	461	480	0	29.411924	5.241088	.063728	13.160663	.077503	.0012048	881.366	77.018	-.00743	.00421
22	471	428	490	3	29.185164	8.951977	-.166210	16.863251	.046510	-.0004865	884.958	94.231	0.00000	.00256
13	472	462	481	0	30.683728	0.000000	1.162828	8.053241	.178885	.0611015	992.456	2.512	0.00000	0.00000
14	473	463	482	0	3.963193	.207537	1.126896	8.257640	.169109	.0164061	984.245	2.682	-.11008	.00141
15	474	464	483	0	5.744595	.410226	1.092981	8.457470	.167290	.0410035	978.510	2.806	-.10868	.00247
16	475	465	484	0	3.441331	.608712	1.060364	8.653250	.162209	.0548573	969.838	2.945	-.02718	.00326
17	476	466	485	0	8.409010	.803230	1.029418	8.845281	.157214	.0334646	961.366	4.703	-.01101	.00398
18	477	467	486	0	4.719882	1.181175	.972203	9.218829	.146305	.0251078	947.802	6.564	.00653	.00525
19	478	468	487	0	15.610530	1.545267	.920498	9.579175	.137830	.0231465	935.318	17.606	.05185	.00606
20	479	469	488	0	30.112369	2.886787	.754009	10.910016	.112700	.0158636	904.252	41.824	-.01744	.00577
21	480	470	489	3	29.886125	5.184970	.536521	13.197189	.076586	.0026629	889.002	57.264	0.00000	.00391
13	481	472	492	0	31.116155	0.000000	1.589170	8.125471	.158436	.0374681	996.624	2.388	0.00000	0.00000
14	482	473	493	0	4.399292	.205379	1.557221	8.328347	.153923	.0531654	986.556	2.621	.03211	.00052
15	483	474	494	0	6.183995	.406239	1.526857	8.526897	.150441	.0356828	976.437	2.779	.02185	.00109
16	484	475	0	0	3.883538	.602713	1.497325	8.721138	.150109	-.0001350	972.562	2.855	-.03586	.00165
17	485	476	495	0	8.853820	.795271	1.469248	8.911627	.142159	.0341993	968.432	4.432	.00140	.00209
18	486	477	496	0	5.169977	1.169076	1.417861	9.281864	.134570	.0270169	955.247	6.147	-.00465	.00287
19	487	478	497	0	16.064756	1.529521	1.370740	9.639190	.127140	.0238962	944.737	16.377	.01463	.00347
20	488	479	498	0	30.577671	2.860112	1.216546	10.960660	.105461	.0152494	916.689	39.237	-.00788	.00433
21	489	480	499	0	30.363464	5.142321	1.012488	13.233352	.074964	.0041226	896.683	70.880	-.00306	.00348
22	490	471	500	0	30.150851	8.823861	.798430	16.908207	.046454	.0006031	890.260	114.368	-.00314	.00234
23	491	429	501	3	29.960003	14.456202	.592682	22.536428	.026612	-.0000530	891.536	138.572	0.00000	.00152

IDENT= NASA INLET CONFIGURATION NO. 8

STREAMTUBE CURVATURE PROGRAM

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
13	492	481	502	0	31.981008	0.000000	2.445267	8.247978	.126119	.0333060	984.769	2.661	0.00000	0.00000
14	493	482	0	0	5.269794	.202205	2.419367	8.448519	.130783	-.0000142	982.409	2.699	-.07704	.00033
15	494	483	503	0	7.059681	.400108	2.394527	8.644856	.120106	.0335800	978.908	4.147	.03934	.00041
17	495	485	504	0	9.741647	.783289	2.349729	9.025408	.116406	.0238036	968.194	5.706	-.00246	.00080
18	496	486	505	0	6.066665	1.151823	2.307794	9.391547	.110866	.0258422	959.207	5.909	.00667	.00114
19	497	487	506	0	16.969292	1.507214	2.269073	9.744821	.107673	.0191421	951.285	15.271	-.00265	.00147
20	498	488	507	0	31.503728	2.820819	2.138094	11.051856	.092057	.0136967	929.589	36.340	.00319	.00239
21	499	489	508	0	31.308941	5.078466	1.955468	13.302000	.070031	.0063081	908.186	66.768	-.00711	.00262
22	500	490	509	0	31.105344	8.734416	1.751914	16.952080	.045324	.0017609	895.678	110.695	-.00132	.00204
23	501	491	510	3	30.917940	14.348049	1.550280	22.561894	.026512	.0002618	893.727	136.639	0.00000	.00142
13	502	492	516	0	32.845861	0.000000	3.304506	8.346203	.104577	.0145538	964.291	6.250	0.00000	0.00000
15	503	494	0	0	7.933364	.397033	3.262891	8.741050	.105440	-.0000126	962.384	6.224	-.01663	.00030
17	504	495	517	0	10.621023	.777269	3.224067	9.119296	.098570	.0167567	959.207	6.101	.01368	.00049
18	505	496	0	0	6.951655	1.142505	3.188066	9.482754	.099434	-.0000095	956.062	6.010	-.01573	.00074
19	506	497	518	0	17.858946	1.494685	3.154307	9.833310	.092059	.0159552	953.074	14.825	.00020	.00089
20	507	498	519	0	32.411845	2.796195	3.042836	11.130017	.080633	.0114617	935.898	34.729	.00049	.00144
21	508	499	520	0	32.236919	5.036206	2.881361	13.364148	.063931	.0068345	916.452	63.741	-.00084	.00189
22	509	500	521	0	32.042917	8.671033	2.688561	16.993737	.043513	.0021026	902.082	107.208	-.00049	.00173
23	510	501	522	0	31.868665	14.267530	2.500676	22.586932	.026115	.0005737	895.866	166.767	-.00105	.00130
24	511	430	530	0	31.734672	22.565842	2.337425	30.883535	.014591	.0001325	893.925	179.554	.00003	.00080
25	512	431	531	0	31.681428	29.068311	2.257776	37.385489	.010359	.0000504	893.500	146.531	-.00004	.00057
26	513	432	532	0	31.652383	34.597222	2.206956	42.914153	.008129	.0000266	893.328	181.212	-.00006	.00044
27	514	433	533	0	31.623713	43.928837	2.143391	52.245537	.005792	.0000090	893.205	210.231	-.00001	.00032
28	515	434	534	0	31.607959	51.829951	2.102342	60.146537	.004599	.0000024	893.174	3966.019	-.00390	.00027
13	516	502	523	0	34.575568	0.000000	5.026696	8.506938	.083116	.0099017	958.062	12.638	0.00000	0.00000
17	517	504	524	0	12.369527	.764979	4.966068	9.269507	.075560	.0095590	950.793	12.779	.00330	.00019
19	518	506	525	0	19.624569	1.472770	4.914173	9.975391	.071648	.0071633	945.161	18.281	.00052	.00037
20	519	507	526	0	34.200494	2.758470	4.826871	11.258119	.064031	.0071010	936.324	34.149	-.00182	.00066
21	520	508	527	0	34.056587	4.974001	4.697946	13.469876	.052765	.0054379	923.170	61.167	.00004	.00102
22	521	509	528	0	33.891388	8.577844	4.535456	17.070014	.038747	.0030533	909.111	103.202	-.00111	.00120
23	522	510	529	3	33.727501	14.144954	4.358909	22.634249	.024677	.0009730	899.728	131.502	0.00000	.00108
13	523	516	535	0	36.305274	0.000000	6.751468	8.637270	.068303	.0077929	948.357	13.391	0.00000	0.00000
17	524	517	0	0	14.108020	.755603	6.700295	9.391137	.067252	-.0000014	946.477	13.074	-.00818	.00016
19	525	518	536	0	21.369879	1.455421	6.655735	10.089533	.059293	.0069929	944.003	18.257	.00385	.00021
20	526	519	537	0	35.962522	2.728345	6.585912	11.360534	.052665	.0057987	936.285	33.736	.00047	.00037
21	527	520	538	0	35.839327	4.926202	6.478609	13.555764	.043906	.0045005	925.682	59.846	-.00023	.00061
22	528	521	539	0	35.700093	8.508203	6.342985	17.135170	.033362	.0029009	913.467	100.702	-.00014	.00082
23	529	522	540	0	35.558607	14.052770	6.189503	22.677580	.022535	.0013663	902.939	160.117	-.00071	.00084
24	530	511	541	0	35.441780	22.312564	6.044160	30.936050	.013562	.0004223	896.971	175.462	-.00019	.00062
25	531	512	542	0	35.393872	28.800172	5.970029	37.423222	.009868	.0002137	895.321	144.811	-.00012	.00049
26	532	513	543	0	35.366356	34.321116	5.920809	42.943942	.007853	.0001219	894.521	180.002	-.00003	.00040
27	533	514	544	0	35.340245	43.644280	5.859861	52.266899	.005677	.0000529	893.850	209.315	-.00007	.00030
28	534	515	545	0	35.325201	51.541033	5.819545	60.163546	.004534	.0000325	893.577	3955.816	.00013	.00025
13	535	523	546	0	39.764687	0.000000	10.205391	8.830697	.044627	.0061792	946.899	25.582	-0.00000	0.00000
19	536	525	547	0	24.864212	1.428900	10.145925	10.258355	.038630	.0048321	939.575	25.122	-.00047	.00010
20	537	526	548	0	39.480017	2.684130	10.100064	11.512746	.034729	.0043986	934.154	33.698	-.00039	.00017
21	538	527	549	0	39.393679	4.857766	10.030571	13.685267	.029517	.0035955	926.076	59.094	-.00015	.00027
22	539	528	550	0	39.295145	8.410867	9.936576	17.237119	.023577	.0025428	916.062	98.765	-.00010	.00040
23	540	529	551	0	39.195676	13.925214	9.825840	22.750344	.017436	.0014377	906.182	157.176	-.00003	.00050
24	541	530	552	0	39.103073	22.158284	9.705158	30.982515	.011722	.0005829	899.060	173.030	-.00008	.00045
25	542	531	553	0	39.064344	28.633905	9.640337	37.457807	.008923	.0003014	896.624	143.560	.00001	.00038
26	543	532	554	0	39.040811	34.148123	9.595159	42.971837	.007292	.0001837	895.449	179.052	-.00004	.00033
27	544	533	555	0	39.018178	43.463816	9.537738	52.287348	.005425	.0000840	894.393	208.551	.00000	.00026
28	545	534	556	0	39.004746	51.356526	9.499054	60.179963	.004377	.0000526	893.944	3946.532	-.00516	.00022

IDENT= NASA INLET CONFIGURATION NO. 8

FIELD TABLE DUMP

J	M	MU	MD	I	S1	S2	Z	R	PHI1	CURV	VM	B	RHS	DS2
13	546	535	557	0	43.224099	0.000000	13.662704	8.949206	.024090	.0058687	943.395	25.923	0.00000	0.00000
19	547	536	558	0	28.350765	1.413835	13.630872	10.362681	.020944	.0053118	935.903	25.485	.00021	.00005
20	548	537	559	0	42.987137	2.659064	13.605866	11.607659	.019455	.0043106	930.324	34.220	-.00005	.00008
21	549	538	560	0	42.930069	4.819822	13.565970	13.768048	.017555	.0031689	922.897	59.785	-.00005	.00014
22	550	539	561	0	42.866979	8.358312	13.507735	17.306058	.015293	.0020952	914.446	99.204	-.00000	.00022
23	551	540	562	0	42.802647	13.857111	13.432403	22.804339	.012631	.0012270	906.268	156.859	.00001	.00029
24	552	541	563	0	42.737038	22.074572	13.338915	31.021264	.009605	.0005824	899.844	172.251	-.00003	.00031
25	553	542	564	0	42.708548	28.541811	13.284414	37.488271	.007783	.0003244	897.294	142.913	-.00001	.00028
26	554	543	565	0	42.689967	34.050868	13.244227	42.997180	.006586	.0002030	896.011	178.443	-.00002	.00026
27	555	544	566	0	42.671935	43.360412	13.191444	52.306572	.005088	.0001001	894.799	207.992	.00003	.00021
28	556	545	567	0	42.660634	51.249526	13.154908	60.195600	.004174	.0000588	894.263	3938.478	-.00615	.00018
13	557	546	568	0	50.142924	0.000000	20.581175	9.000000	.000000	-.0000000	908.511	32.059	0.00000	0.00000
19	558	547	569	0	35.300314	1.420576	20.580064	10.420575	.001564	.0002647	908.337	30.160	.00007	.00001
20	559	548	570	0	49.958944	2.669613	20.577313	11.669610	.002776	.0004737	907.910	38.696	.00003	.00002
21	560	549	571	0	49.934113	4.833970	20.569651	13.833953	.004217	.0006397	906.795	65.106	.00003	.00004
22	561	550	572	0	49.911580	8.373648	20.551984	17.373587	.005552	.0006701	904.663	104.309	.00004	.00007
23	562	551	573	0	49.889541	13.868961	20.518992	22.868801	.006375	.0005384	901.645	160.563	.00003	.00010
24	563	552	574	0	49.863917	22.077448	20.465473	31.077113	.006376	.0003235	898.471	173.860	.00002	.00013
25	564	553	575	0	49.850300	28.537051	20.426002	37.536596	.005893	.0002046	896.954	143.121	.00000	.00014
26	565	554	576	0	49.840724	34.040187	20.394857	43.039643	.005368	.0001379	896.116	178.151	.00000	.00014
27	566	555	577	0	49.829977	43.341279	20.349405	52.340623	.004453	.0000775	895.257	207.441	-.00003	.00013
28	567	556	578	0	49.823040	51.224588	20.317258	60.223866	.003703	.0000727	894.748	3926.218	.01267	.00011
13	568	557	0	0	57.061750	0.000000	27.500000	9.000000	0.000000	.0000000	895.415	34.449	0.00000	0.00000
19	569	558	0	0	42.219791	1.427172	27.499538	10.427172	.000648	-.0000000	895.415	32.360	.00000	.00000
20	570	559	0	0	56.880078	2.681260	27.498437	11.681259	.001137	-.0000000	895.415	41.345	-.00000	.00001
21	571	560	0	0	56.859386	4.852930	27.494897	13.852927	.002001	-.0000000	895.415	69.035	.00000	.00001
22	572	561	0	0	56.845611	8.401362	27.485958	17.401347	.003229	-.0000000	895.415	109.242	-.00000	.00002
23	573	562	0	0	56.833870	13.904479	27.463229	22.904416	.004506	-.0000000	895.415	165.526	.00000	.00003
24	574	563	0	0	56.823121	22.116419	27.424666	31.116266	.005251	-.0000000	895.415	177.052	.00000	.00004
25	575	564	0	0	56.813975	28.574576	27.389574	37.574328	.005181	-.0000000	895.415	144.328	-.00000	.00005
26	576	565	0	0	56.808355	34.075127	27.362400	43.074811	.004887	-.0000000	895.415	178.574	-.00000	.00005
27	577	566	0	0	56.799890	43.370820	27.319254	52.370403	.004183	-.0000000	895.415	207.270	.00000	.00007
28	578	567	0	0	56.795016	51.248976	27.289190	60.248502	.003449	-.0000000	895.415	3911.084	-.01169	.00008

SUBROUTINES ADJWF, BRHS, FLOBAL, WRIBDY, WRIOUT

AREA	AREAO	DISP	PT	LAMBDA	RHO	SQRTVV
0.	0.	0.	2.24016E+01	1.00000E+00	1.83805E-05	1.00171E+00
1.03651E+01	1.05413E+01	0.	2.24016E+01	1.00000E+00	1.83932E-05	1.00158E+00
2.07405E+01	2.10885E+01	0.	2.24016E+01	1.00000E+00	1.84048E-05	1.00431E+00
4.15278E+01	4.22176E+01	0.	2.24016E+01	1.00000E+00	1.84363E-05	1.00391E+00
6.23666E+01	6.33822E+01	0.	2.24016E+01	1.00000E+00	1.84647E-05	1.00013E+00
8.32309E+01	8.45491E+01	0.	2.24016E+01	1.00000E+00	1.84657E-05	9.99282E-01
1.04091E+02	1.05718E+02	0.	2.24016E+01	1.00000E+00	1.84604E-05	9.64177E-01
1.24724E+02	1.26731E+02	0.	2.24016E+01	1.00000E+00	1.81867E-05	6.64704E-01
1.34317E+02	1.36464E+02	0.	2.24016E+01	1.00000E+00	1.36825E-05	5.87543E-01
1.47675E+02	1.49725E+02	0.	2.24016E+01	1.00000E+00	3.66295E-06	1.18142E+00
1.63162E+02	1.63162E+02	0.	2.24016E+01	1.00000E+00	7.06562E-06	9.35658E-01

TS	TT	VMSQ	VVKQKP	WQA	WSTA	RG	C2CP	FGR
5.41452E+02	5.85080E+02	5.24117E+05	1.00342E+00	1.33068E-02	0.	1.71620E+03	1.20134E+04	2.50000E+00
5.41601E+02	5.85080E+02	5.22331E+05	1.00316E+00	1.32932E-02	1.38262E-01	1.71620E+03	1.20134E+04	2.50000E+00
5.41738E+02	5.85080E+02	5.20685E+05	1.00863E+00	1.32806E-02	2.76524E-01	1.71620E+03	1.20134E+04	2.50000E+00
5.42109E+02	5.85080E+02	5.16228E+05	1.00784E+00	1.32463E-02	5.53047E-01	1.71620E+03	1.20134E+04	2.50000E+00
5.42443E+02	5.85080E+02	5.12215E+05	1.00025E+00	1.32151E-02	8.29571E-01	1.71620E+03	1.20134E+04	2.50000E+00
5.42454E+02	5.85080E+02	5.12086E+05	9.98564E-01	1.32141E-02	1.10609E+00	1.71620E+03	1.20134E+04	2.50000E+00
5.42392E+02	5.85080E+02	5.12823E+05	9.29637E-01	1.32198E-02	1.38262E+00	1.71620E+03	1.20134E+04	2.50000E+00
5.39162E+02	5.85080E+02	5.51638E+05	4.41831E-01	1.35077E-02	1.65914E+00	1.71620E+03	1.20134E+04	2.50000E+00
4.81152E+02	5.85080E+02	1.24853E+06	3.45207E-01	1.52884E-02	1.79740E+00	1.71620E+03	1.20134E+04	2.50000E+00
2.84020E+02	5.85080E+02	3.61675E+06	1.39575E+00	6.96611E-03	1.93567E+00	1.71620E+03	1.20134E+04	2.50000E+00
3.69383E+02	5.85080E+02	2.59126E+06	-8.51110E-15	1.13738E-02	2.07393E+00	1.71620E+03	1.20134E+04	2.50000E+00

BLBDY

1	CNTLN		0	0
4	NACA1		0	0
7	CLEX		1	0
10	FF		0	0
13		0	0	0
16		0	0	0
19		0	0	0
22		0	0	0
25		0	0	0
28		0	0	0
31		0	0	0
34		0	0	0
37		0	0	0
40		0	0	0
43		0	0	0
46		0	0	0
49		0	0	0
52		0	0	0
55		0	0	0
58		0	0	0

BLTAB

```
DMPX.

P   000000  A0  057116  B0  000000
RA  121100  A1  057101  B1  067213   C(A1)=  0000  0000  0000  0006  7176    C(B1)=  0214  2401  0255  5555  5555
FL  146000  A2  057147  B2  067555   C(A2)=  5555  5555  5555  5555  5555    C(B2)=  0315  5555  5555  5555  5555
EM  070000  A3  645332  B3  067553   C(A3)=                                  C(B3)=  5555  5555  5555  5555  5555
RE  000000  A4  057111  B4  067176   C(A4)=  0000  0000  0000  0000  0000    C(B4)=  0000  0000  0000  0000  0003
FE  000000  A5  057100  B5  067555   C(A5)=  0006  7553  0675  5506  7213    C(B5)=  0315  5555  5555  5555  5555
MA  000000  A6  057111  B6  000001   C(A6)=  0000  0000  0000  0000  0000    C(B6)=  0000  0000  0000  0000  0000
            A7  003646  B7  063263   C(A7)=  0000  0000  0000  0000  2737    C(B7)=  0000  0000  0000  0000  0001
X0  0000  0000  0000  0000  3662
X1  0000  0000  0000  0006  7176
X2  5555  5555  5555  5555  5555
X3  0000  0000  0000  0000  0000
X4  0000  0000  0000  0000  0000
X5  0000  0000  0000  0006  7553
X6  0000  0000  0000  0000  0000
X7  0000  0000  0000  0000  2737

00000   00010 56720 00000 00000   00000 00000 00000 00000   11162 02524 00000 01617   17252 42025 24000 03641
00004   24012 00540 00000 05663   24012 00541 00000 03641   24012 00534 00000 07705   24012 00535 00000 11727
00010   24012 00537 00000 11727   00000 00000 00000 00000
00054  *51300 00001 03130 00054   54110 63310 21144 73110   03010 00060 66320 56610   54160 03110 00057 54760
00060   02300 00000 00000 00021   11162 60114 11045 51726   05221 40131 46140 52605   14551 72255 06270 10000
00064   00000 00000 00000 00000   00000 00000 00000 77354   00140 55640 00000 72674   00000 00000 60001 41655
00070   05301 12457 55000 00000   00000 00000 00000 00000
00100  *50000 00000 01000 00454

56620   51100 56624 10711 46000   01000 60024 07000 56527   17214 00000 00000 00000   17204 00000 00000 00000
56624   00000 00000 00000 00000   05160 40000 00000 00000   00000 00000 00000 00000   56661*24010 22022 24000 00004
56662   04000 67133 00000 00000   43052 76710 15770 76120
56664   15110 20122 36717 76230   15220 20244 12727 46000   51700 57100 76740 46000   51700 57101 56440 10644
56670   71500 00012 37765 46000   03370 56672 10655 46000   10777 51600 57144 56130   10611 51600 57145 46000
56674   61300 57073 61200 57066   67202 66100 46000 46000   01000 61635 07000 56661   51200 57100 66200 63120
56700   01000 61635 00000 00000   61107 77776 01000 61635   51300 47661 10633 46000   51600 57146 10466 10644
56704   51600 57147 43600 46000   51600 57150 46000 46000   61300 57075 61200 57066   67202 66100 46000 46000
56710   01000 61635 07000 56661   61107 77776 01000 61635   51500 57100 51100 57101   63150 21522 63250 21522
56714   63350 63410 51200 57147   66520 53325 10633 46000   51600 57111 51400 57111   71500 00001 37645 43774
56720   37667 03360 56722 46000   03060 56722 43700 46000   10377 10144 51200 57132   37612 43774 03260 56725
56724   03060 56725 43700 46000   10477 12634 47606 46000   03060 56727 10622 54640   54540 51100 57147 46000
56730   71200 00001 36651 37662   54650 04000 57052 00000   71600 00001 51600 57151   51300 57147 61527 77776
56734   53435 10644 51600 57112   51500 57143 10166 11651   51600 57152 10266 37625   03060 57003 51300 57141
56740   11631 51600 57130 10466   51500 57131 37645 46000   03060 57000 51100 57112   51200 00150 37612 46000
56744   03060 57006 51300 57142   11631 51600 57153 10466   03040 57003 51500 57112   10655 21674 13656 54650
56750   51100 57151 52010 57113   51200 57136 10622 54600   54350 51400 57067 31734   24607 43774 37667 46000
56754   03360 56755 43700 46000   10277 10533 51100 57070   31751 24607 43774 46000   03260 56761 03060 56761
56760   43700 46000 46000 46000   10377 12623 47606 46000   03160 57010 46000 46000   51400 57151 52040 57113
56764   51500 57135 10655 54600   51100 57112 51200 57071   31712 24607 03060 56770   03360 56772 46000 46000
56770   54340 52030 57113 46000   51400 57134 10644 54600   54310 51400 57072 31734   24607 03060 56775 46000
56774   03360 56777 46000 46000   51500 57151 52050 57113   51100 57133 10611 54600   04000 57010 00000 00000
57000   51500 57151 52050 57113   51100 57137 10611 54600   04000 57010 00000 00000   51200 57151 52020 57113
57004   51300 57127 10633 54600   04000 57010 00000 00000   51400 57151 52040 57113   51500 57140 10655 54600
57010   51100 57151 71200 00001   36612 54610 51300 57147   36632 54630 10466 46000   51500 57111 37645 46000
57014   03060 57015 03260 57027   10777 54110 51200 57144   37612 43774 37667 46000   03360 57021 03060 57021
57020   43700 46000 46000 46000
```

SECTION 10.0

OPERATING PROCEDURES

The STC program described herein may be run on any Control Data 6400/6600 machine operating under SCOPE 3.0 or a higher level operating system. In general, operating procedures and control card set-ups will differ from site to site. The following comments on program modifications, deck set-ups, and operating instructions are restricted to the program as installed at the Langley Research Center. Minimal changes should be necessary for successful installation at other CDC sites.

10.1 GENERAL OPERATING PROCEDURES

The version of STC available at the LRC computer site allows a maximum flow field data storage of 768 grid points, and requires a field length of 115_8 K for execution from an absolute overlay file.

A larger version of STC may be created by recompilation (FORTRAN IV RUN compiler) of the two block data subprograms which set the size of the STC table and field point storage (USECDG) and the size of the influence coefficient arrays used in the solution for the streamline adjustment (USECDM).

1.) Block Data USECDG (overlay 0,0)

Common	Variable	Table/Description
/CDS2/	C12	Field Table - Streamline adjustment
/CRHS/	C16	Field Table - Right hand side of matrix equation.
/CHDATA/	C9	STC Table Storage
/CCURV/	C11	Field Table - Streamline Curvatures
/CPHI1/	C14	Field Table - Flow Angle
/CS1/	C17	Field Table - Distance along streamlines
/CS2/	C18	Field Table - Distance along orthogonal lines
/SLTAB/	C8	Streamline Table - Dimension 3* maximum number of streamlines
/CM/	C13	Field Table - JMS (mesh point connection) array
/CB/	C10	Field Table - Coefficient B in matrix equation
/CZ/	C20	Field Table - Axial coordinate (X,Z)
/CR/	C15	Field Table - Normal coordinate (Y,R)
/CVM/	C19	Field Table - Velocity

As indicated in the preceding list, 11 variables comprise the flow field tables. These arrays should be dimensioned to the maximum number of mesh points. The exception is /CDS2/, which must be set to a minimum of 900 locations.

Note also that /CZ/ and /CR/ must reside next to each other in memory, as these quantities are used to determine the maximum limit for the number of field points. For problems with a large quantity of boundary input, many boundary layer surfaces, and/or a large number of anticipated orthogonal stations, it may be necessary to increase the size of the STC Table storage common /CHDATA/ beyond the 2200 locations currently allocated. The streamline storage /SLTAB/ is set to accommodate 128 streamlines; this should be of adequate size for most problems. As in the case of /CZ/ and /CR/, the commons /CHDATA/ and /CEND/ must be located adjacent to one another in memory. These items are used to set the maximum limit for the STC table storage.

2.) Block Data USECDM (Overlay 4,0)

Common	Variable	Description
/CA2/	C42	Curvature influence coefficient A2
/CA3/	C43	Curvature influence coefficient A3
/CA4/	C44	Streamline flow difference influence coefficient A4
/CA5/	C45	Curvature influence coefficient A5
/CA6/	C46	Curvature influence coefficient A6
/CA7/	C47	Streamline flow difference influence coefficient A7
/CA8/	C48	Streamline flow difference influence coefficient A8

The dimension of the arrays in these commons should be the same as the dimension of the flow field arrays.

10.2 RECOMMENDED PROCEDURES FOR PROGRAM MAINTENANCE AND MODIFICATION

As mentioned previously, a source and absolute binary copy of the STC program are stored on the permanent disc file (data cell) at the LRC computer center. It is recommended that relocatable binary copies of each version be maintained on tape. As changes are made to the program, only those routines which differ need be recompiled. The relocatable binary tape may be updated using standard COPYL and COPYN functions. Subsequent execution from this file will result in the creation of a new absolute binary file which may replace the one currently on the data cell. The updated source decks may also be updated at this time.

The source copy of STC contains *DECK cards as the first card of each subroutine. In running at other CDC sites, the source file may be used directly to initialize an update tape.

10.3 STANDARD EXECUTION DECK SET-UPS

Normally, the absolute binary (overlay) program will be reloaded from the data cell for execution. The suggested deck set-up is:

```
∇
(Job Card)
(User Card)
FETCH (A3727, address on data cell, BINARY, STC)
COPYBR (INPUT, TAPE5)
STC.
789 (EOR)
[Input Data]
6789 (EOF)
```

As indicated previously, this deck set-up is applicable at the NASA Langley Research Center computer site. At other installations, the absolute binary file may be reloaded from tape. For example, a typical deck set-up for use on the CDC Cybernet System is:

```
∇
(Job Card)
LABEL (STCOVLY, R, VSN = UT611)
COPYBF (STCOVLY, STC)
REWIND (STC)
COPYBF (INPUT, TAPE 5)
STC.
789 (EOR)
[Input Data]
6789 (EOF)
```

10.4 RESTART OF STC PROGRAM FROM DATA TAPE

A partially completed STC problem may be restarted using the output data tape from the previous STC execution. The restart tape is obtained by specifying TAPOT as T on the general input header card and using a file card such as REQUEST or LABEL to assign TAPE2 to a given physical device. Of course, the logical file TAPE2 must be assigned with "write permit" RING option. In the subsequent restart task, TAPIN must be specified as T on the general input header card. Also, the input file TAPE1 must be defined using an appropriate file card (NORING). The input for the restart case should consist of the identification cards, the general input header card, and the first $A namelist. For example, to restart a job after 3 major grid refinements and run to 5 grid refinements, the example input might appear as:

```
NAME = J. Smith
ADDRES = LRC
IDENT = NASA 8 INLET
2    4        14        24
1    STC      T         F
$A
MAXIT = 5,
$
```

Intermediate output at a given MAXIT level may be obtained by running a restart case and not assigning TAPE2 and TAPE1. In this instance, these files are assigned to disc and switched at the end of each total set of input. This option is also useful for changing program tolerance at a given stage of the calculation.

The preceding example could be run as one case using the following input:

```
NAME = J. Smith
ADDRES = LRC
IDENT = NASA 8 1 INLET
2    4        14        24
1    STC      F         T
$A
MAXIT = 3
:
$
1    STC        T         F
$A
MAXIT = 5,
$
```

Successive restart cases may be stacked in sequence. On all but the final one, use 1 STC T T as the header card.

As indicated in above, a partially completed STC problem may be restarted using the output data from a previous STC execution. When used for a boundary layer run, the output tape may also contain the boundary layer data from the previous run. If TAPOT and TAPIN are specified as T and TAPE2 and/or TAPE1 are not assigned to a tape file, the system will assign them to disc. Hence, consecutive boundary layer restart cases may be run by simply setting TAPIN and TAPOT to T on all cases after the first. The general procedure for carrying out a boundary layer iteration would be to run a given STC problem to a specified refinement/or convergence level and then run successive restart cases at the same level to converge the combined inviscid - boundary layer problem.

SECTION 11.0

HELPFUL USER HINTS

11.1 GENERAL COMMENTS

The following section is a compilation of information for the user. Many items have been covered elsewhere, but they will be repeated in this section for emphasis. The intent is to identify key input parameters so that computer solutions can be accomplished with minimum user problems or errors.

The primary items of importance are:

1. Smooth input geometry
2. Grid refinement definition
3. Iteration tolerances
4. How to get out of trouble when the solution doesn't converge.

11.2 SMOOTH INPUT GEOMETRY

The Streamtube Curvature method uses the boundary or body surface curvature as the geometry parameter which causes velocity and/or pressure gradients. Thus, the computer program is very sensitive to changes in curvature. Hence, an accurate definition of the boundary coordinates and local angles is imperative if surface curvatures are to be smooth and continuous.

There are two methods to insure smooth input geometry; (1) use an analytic boundary or function with continuous first (angle) and second derivatives (curvature) or (2) smooth specified boundary coordinates by fitting a curve to the surface points. The definition of an analytic boundary is not always possible and, in some cases, the intersection of two analytic functions will have discontinuous second derivatives. (An ASME nozzle is an ellipse followed by a straight line. The discontinuous second derivative causes a pressure "blip".) Hence, a curve fit technique may be necessary in most cases.

The best curve fit to use is a piecewise smooth cubic since the curvatures are evaluated in STC using the same type of curve fit. Hence, the definition of the coordinates and angles should come from some such geometry smoothing method. As part of the geometry definition, the curvatures should be checked for discontinuities or erratic behavior.

11.3 GRID REFINEMENT

The grid refinement criteria is explained in detail in Section 13. Some comments on use are appropriate with reference to Figure 31.

First of all, the purpose of the grid refinement criteria is to maximize the grid refinement in areas of interest and to minimize the flow field grid refinement in areas of smooth flow. By forcing flow field grid points to be used efficiently, computer table size and storage space is minimized and computer time is reduced. Also, the flow field grid can develop without over-constraining the streamlines.

The best technique is to first identify the region or regions in the flow field where a high degree of resolution is necessary. The geometric grid refinement criteria in this area is set at a value equal to the grid size desired. As shown in Figure 31, a rectangular flow field section on the inlet lip is defined with SGZ = SGR. If a subsidiary plot of SGR vs GR and SGZ versus GZ are set up, the input table is readily developed. In the radial direction, SGR is specified at the centerline, decreases linearly to the region of interest, increases linearly to the outer region value and is constant from there out. In the axial direction, a similar plot can be drawn. The coordinates of these two plots become the input tables for GZ/SGZ and GR/SGR.

In some problems, the geometric grid refinement must be redefined if solution difficulties occur. A demand for excessive grid refinement in a local area can over-constrain the development of the flow field. Only experience will allow the user to make the optimum choice of grid refinement criteria for different problems.

11.4 ITERATION TOLERANCES

The iteration tolerances, TØLINR and TOLES2, have been preset at recommended values for most problems. As explained in Section 9.1, these tolerances control the iteration logic for the grid refinement and the "flow balance" or inner loop solution.

Usually, if the input geometry is properly defined and no errors are made in defining the flow properties (such as setting VARY = T in all the channels), the solution proceeds through several grid refinements with no problems.

When the grid refinement criteria and the iteration tolerances are incompatible, i.e., the tolerances are very small and the grid refinement has high resolution in an area of large streamline curvature, the solution will show instability in the definition of streamline adjustment (MAX-ES2 will not decrease continuously). The remedy is to change the tolerances or the grid refinement or both.

One good procedure is to keep the iteration tolerances relatively large during the flow field grid development and then restart the last grid refinement with smaller tolerances. Again, experience in use of the computer analysis will be necessary to provide guidance in how to do this.

11.5 TROUBLE SHOOTING

The Streamtube Curvature Analysis has been set up as a user oriented computer program for the solution of relatively complex subsonic and transonic flow field problems. Many of the control variables have been preset to the most generally useful value. Hence, a majority of problems will be solved quickly and accurately if the inputs (geometry and channel flow properties) have been defined correctly. But, there will be instances when numerical difficulties will occur.

Invariably, a large percentage of the numerical difficulties can be related to errors in defining the geometry or bad judgement in selecting the grid refinement or iteration tolerances. However, when large supersonic bubbles are present in a transonic flow, convergence problems in the inner loop have been experienced. A dump, very similar to that shown in Section 9.3, will result. The solution history gives the first diagnosis in that the level of grid refinement, the number of inner iterations during the last refinement, and the behavior of MAX-ES2 can be quickly reviewed. Often MAX-ES2 will start to converge and then show instability. By identifying the appropriate NINNER, the solution can be forced to the preceding level of grid refinement by rerunning the problem with the NINNER control inserted. Convergence difficulties for this type of problem may sometimes be overcome by establishing a refined grid at a lower Mach number and slowly raising the Mach number to the desired level using restart cases.

SECTION 12.0

SAMPLE CASES - PROGRAM OUTPUT

Three sample cases have been selected to illustrate the typical input/output for the STC program. The first sample case is the analysis of an inlet lip at a free stream Mach number of 0.8 (NASA Inlet No. 8). This example case is identical to the one presented in the previous STC-SAB user manual, except the inlet surface has no boundary layer. The geometry is defined as a straight centerline for the lower boundary of the inlet flow (BDY CNTLN W2 and UPPER = F), the coordinates and angles for the inner surface of the inlet lip, the NACA Series 1 external cowl lip (CLEX), and a far-field (FF) upper boundary. Three (3) passes through the program are shown with MAXIT = 8. On the third pass, the tolerance (TOLES2) was reduced from 1. to .001 to obtain more accuracy in the inviscid solution. Also, on the final restart, the output indicator PRPRN was set to 1 to obtain a full printout of the flow field.

The second case illustrates the boundary layer on a two-dimensional circular arc airfoil in a wind tunnel at M_o = .663. As indicated in the output, boundary layer separation occurred at SW = 19.88. Upon restart, the previously described warning comment is printed each time the boundary is accessed to determine an orthogonal - boundary intersection.

The final test case illustrates the revised flow adjustment procedure and alteration of the STC wake table to reflect boundary layer displacement effects at a trailing edge. The problem configuration consists of an outer nacelle portion (BODY) and an ideally expanded CD nozzle (NOZZLE, CNTLN) at a subsonic Mach number of 0.2. The nozzle lip trailing edge thickness (TTE) was 0.005 and boundary layers were specified on both surfaces. The outer upper surface was taken as a far-field (FF) boundary. The solution was run to MAXIT = 8 and a tolerance (TOLES 2) of 0.005 in two passes, the restart portion being used to provide displacement correction of the initial inviscid solution.

CARD INPUT

```
NAME= D A V E   F E R G U S O N
ADDRES=  EVENDALE
IDENT=  NASA INLET CONFIGURATION NO. 8
1 STC          F          T
$A
MACHO=.8.
TSO=518.688,PSO=14.69594,RG=1716.2,VMG1=100.,VMG2=100.,
MAXIT=5.
NGR=5.
GR(1)=0.,7.,9.5,10.,20.,
SGR(1)=3.,1.,1.,3.,12.,
NGZ=6.
GZ(1)=-15.,-7.,-2.,2.,7.,15.,
SGZ(1)=12.,5.,1.,1.,5.,12.,
TOLES2=1.
RHL=7.682,RM=9.,
PERRM=-1,
TSIC=0.,
$
2 BDY          CNTLN      W2
$A
UPPER=F.
B(1)=-30.,0.,0.,
18.,0.,0.
$
2 BDY          NACA1      W2
$A
UPPER=T.
B(1)=0.,7.682,-90.,
.01721,7.6100,-64.068,
.03790,7.57593,-53.751,
.05404,7.55603,-48.309,
.08320,7.52723,-41.353,
.11560,7.50136,-36.031,
.1980,7.45181,-26.448,
.3830,7.38728,-13.081,
.5340,7.36163,-6.630,
.7610,7.3480,-0.831,
2.500,7.378,0.995,
4.500,7.413,1.010,
6.300,7.44856,1.852,
8.100,7.52971,3.320,
10.900,7.73329,5.172,
14.400,8.09178,5.742,
16.200,8.26233,4.956,
18.00,8.400,3.791,
$
2 BDY          CLEX       EXT
$A
UPPER=F,BL=T.
ZRONLY=T.
B(1)=991.,1.,0.,7.682,18.,9.,18.,9.,27.5,9.,
$
2 BDY          FF         EXT
$A
UPPER=T.
B(1)=-30.,60.,0.,28.,60.,0.,
$
3 CHN          W2
$A
SO=.5093.
```

```
1 STC          T          T
$A
MAXIT=8,PRPRN=-1,
TOLES2=1.,
$
1 STC          T          F
$A
MAXIT=8,TOLES2=.001,PRPRN=0,
$
```

EXECUTING PROGM=STC
TAPIN= F   TAPOT= T

ROUNDARY COORDINATES. BDY=CNTLN   CHN=W2   UPPER= F   BL= F

I	X.Z	Y.R	ANGD	CURV-	CURV+
1	-30.00000	.00000	.000	.0000	.0000
2	18.00000	.00000	.000	.0000	.0000

ROUNDARY COORDINATES. BDY=NACA1   CHN=W2   UPPER= T   BL= F

I	X.Z	Y.R	ANGD	CURV-	CURV+
1	.00000	7.68200	-90.000	.0000	-6.2709
2	.01721	7.61090	-64.068	-5.1772	-4.9234
3	.03790	7.57593	-53.751	-4.0020	-3.9950
4	.05404	7.55603	-48.309	-3.3938	-3.4187
5	.08320	7.52723	-41.353	-2.4725	-2.4495
6	.11560	7.50136	-36.031	-2.0166	-1.9562
7	.19800	7.45181	-26.448	-1.4862	-1.4424
8	.38300	7.38728	-13.081	-.8893	-.8772
9	.53400	7.36163	-6.630	-.5858	-.5779
10	.76100	7.34800	-.831	-.3086	-.0728
11	2.50000	7.37800	.995	.0362	-.0001
12	4.50000	7.41300	1.010	-.0001	.0092
13	6.30000	7.44856	1.852	-.0256	-.0139
14	8.10000	7.52971	3.320	-.0145	-.0145
15	10.80000	7.73329	5.172	-.0094	-.0094
16	14.40000	8.09178	5.742	.0039	.0039
17	16.20000	8.26233	4.956	.0113	.0113
18	18.00000	8.40000	3.791	.0113	.0000

EXECUTING PROGM=STC
TAPIN= F TAPOI= T

BOUNDARY COORDINATES. BDY=CNTLN CHN=W2 UPPER= F BL= F

I	X.Z	Y.R	ANGD	CURV-	CURV+
1	-30.00000	.00000	.000	.0000	.0000
2	18.00000	.00000	.000	.0000	.0000

BOUNDARY COORDINATES. BDY=NACA1 CHN=W2 UPPER= T BL= F

I	X.Z	Y.R	ANGD	CURV-	CURV+
1	.00000	7.68200	-90.000	.0000	-6.2709
2	.01721	7.61000	-64.068	-5.0772	-4.9234
3	.03790	7.57593	-53.751	-4.0020	-3.9950
4	.05404	7.55603	-48.309	-3.3938	-3.4187
5	.08320	7.52723	-41.353	-2.4725	-2.4495
6	.11560	7.50136	-36.031	-2.0166	-1.9562
7	.19800	7.45181	-26.448	-1.4862	-1.4424
8	.38300	7.38728	-13.081	-.8893	-.8772
9	.53400	7.36163	-6.630	-.5858	-.5779
10	.76100	7.34890	-.831	-.3086	-.0728
11	2.50000	7.37600	.995	.0362	-.0001
12	4.50000	7.41300	1.010	-.0001	.0092
13	6.30000	7.44856	1.852	-.0256	-.0139
14	8.10000	7.52971	3.320	-.0145	-.0145
15	10.80000	7.73329	5.172	-.0094	-.0094
16	14.40000	8.09178	5.742	.0039	.0039
17	16.20000	8.26233	4.956	.0113	.0113
18	18.00000	8.40000	3.791	.0113	.0000

IDENT= NASA INLET CONFIGURATION NO. 8

SEGMENT 2 OF BDY=CLEX

* A CURVE HAS BEEN FITTED TO GIVEN X,Y POINTS *

END CONDITIONS - FENDA(1)= .00000 FENDA(2)= .00000

INPUT COORDINATES XA,ZA	YA,RA	DEVI	DEV *1000	ADJUSTED COORDINATES X,Z	Y,R	ANGD DEGREES	CURV	APPLIED FORCES FOK	ARC LENGTH S
18.00000	9.00000	.00	.00	18.00000	9.00000	.000	.000000	.00000	.00000
27.50000	9.00000	.00	.00	27.50000	9.00000	.000	.000000	.00000	9.50000

SEGMENT 1 OF BDY=CLEX

IDENT= NASA INLET CONFIGURATION NO. 8

* NACA SERIES-1 COWL CONTOUR *

INPUT DATA. X1= .00000 Y1= 7.68200
X2= 18.00000 Y2= 9.00000 A= 1.000

COORDINATE DATA-

					----- BEAM CALCULATED -----		
X/X	Y/Y	Z	R	ANGD	ANGB	CURV	S
.000000	.00000	.00000	7.68200	90.000	90.000	17.500104	.00000
.000106	.01120	.00191	7.69676	75.425	75.462	15.857660	.01492
.000306	.01930	.00551	7.70704	66.085	66.093	13.864206	.02583
.000646	.02750	.01163	7.71824	57.017	56.980	10.807238	.03861
.001300	.03880	.02340	7.73314	47.103	47.026	7.307785	.05761
.002003	.04797	.03606	7.74522	40.627	40.613	5.393196	.07512
.003966	.06671	.07140	7.76992	30.349	30.337	2.832944	.11830
.006002	.08117	.10804	7.78898	25.099	25.143	1.544224	.15961
.008000	.09312	.14400	7.80473	22.362	22.394	.897495	.19888
.010000	.10386	.18000	7.81889	20.601	20.612	.709490	.23756
.015000	.12727	.27000	7.84974	17.511	17.483	.437455	.33272
.020000	.14746	.36000	7.87635	15.633	15.619	.255594	.42657
.025000	.16579	.45000	7.90051	14.505	14.518	.156608	.51976
.030000	.18298	.54000	7.92316	13.753	13.772	.123801	.61257
.035000	.19930	.63000	7.94468	13.120	13.124	.120739	.70510
.040000	.21483	.72000	7.96514	12.509	12.497	.116369	.79740
.045000	.22959	.81000	7.98460	11.927	11.915	.104142	.88948
.050000	.24368	.90000	8.00317	11.406	11.403	.090636	.98138
.060000	.27013	1.08000	8.03804	10.557	10.563	.069178	1.16473
.070000	.29478	1.26000	8.07052	9.922	9.924	.052815	1.34763
.080000	.31804	1.44000	8.10118	9.431	9.426	.042313	1.53023
.090000	.34020	1.62000	8.13038	9.012	9.012	.037041	1.71258
.100000	.36138	1.80000	8.15830	8.611	8.622	.037599	1.89473
.120000	.40087	2.16000	8.21035	7.818	7.827	.038750	2.25848
.140000	.43654	2.52000	8.25736	7.085	7.071	.033938	2.62154
.160000	.46888	2.88000	8.29999	6.486	6.470	.023849	2.98405
.180000	.49879	3.24000	8.33940	6.045	6.051	.016564	3.34621
.200000	.52696	3.60000	8.37653	5.721	5.735	.013928	3.70812
.220000	.55371	3.96000	8.41180	5.453	5.458	.012829	4.06984
.250000	.59148	4.50000	8.46158	5.093	5.085	.011162	4.61213
.300000	.64899	5.40000	8.53737	4.565	4.561	.009082	5.51532
.350000	.70076	6.30000	8.60560	4.111	4.117	.008081	6.41790
.400000	.74746	7.20000	8.66715	3.708	3.712	.007612	7.32001
.450000	.78948	8.10000	8.72253	3.341	3.337	.006913	8.22171
.500000	.82721	9.00000	8.77226	2.999	2.993	.006395	9.12309
.600000	.89087	10.80000	8.85617	2.350	2.351	.006045	10.92505
.700000	.93955	12.60000	8.92033	1.730	1.735	.005886	12.72620
.800000	.97372	14.40000	8.96536	1.128	1.132	.005806	14.52677
.900000	.99365	16.20000	8.99163	.548	.544	.005596	16.32697
1.000000	1.00000	18.00000	9.00000	.000	.000	.004952	18.12700

IDENT= NASA INLET CONFIGURATION NO. 8

CONSOLIDATED OUTPUT DATA

I	S	X,Z	Y,R	ANGD DEGREES	CURV	FOK
1	.00000	.00000	7.68200	90.000	17.500104	115.06761
2	.01492	.00191	7.69676	75.425	15.857660	70.93851
3	.02583	.00551	7.70704	66.085	13.864206	57.23452
4	.03861	.01163	7.71824	57.017	10.807238	-55.33965
5	.05761	.02340	7.73314	47.103	7.307785	-77.68618
6	.07512	.03606	7.74522	40.627	5.393196	-49.61809
7	.11830	.07140	7.76992	30.349	2.832944	-29.23370
8	.15961	.10804	7.78898	25.099	1.544224	-14.86643
9	.19888	.14400	7.80473	22.362	.897495	-11.63365
10	.23756	.18000	7.81889	20.601	.709490	-1.99834
11	.33272	.27000	7.84974	17.511	.437455	-.92552
12	.42657	.36000	7.87635	15.633	.255594	-.87657
13	.51976	.45000	7.90051	14.505	.156608	-.70897
14	.61257	.54000	7.92316	13.753	.123801	-.32044
15	.70510	.63000	7.94468	13.120	.120739	.01427
16	.79740	.72000	7.96514	12.509	.116369	.08543
17	.88948	.81000	7.98460	11.927	.104142	.01420
18	.98138	.90000	8.00317	11.406	.090636	-.02993
19	1.16473	1.08000	8.03804	10.557	.069178	-.02758
20	1.34763	1.26000	8.07052	9.922	.052815	-.03195
21	1.53023	1.44000	8.10118	9.431	.042313	-.02861
22	1.71258	1.62000	8.13038	9.012	.037041	-.03197
23	1.89473	1.80000	8.15830	8.611	.037599	-.00010
24	2.25848	2.16000	8.21035	7.818	.038750	.01642
25	2.62154	2.52000	8.25736	7.085	.033938	.01458
26	2.98405	2.88000	8.29999	6.486	.023849	-.00772
27	3.34621	3.24000	8.33940	6.045	.016564	-.01283
28	3.70812	3.60000	8.37653	5.721	.013928	-.00424
29	4.06984	3.96000	8.41180	5.453	.012829	.00004
30	4.61213	4.50000	8.46158	5.093	.011162	-.00077
31	5.51532	5.40000	8.53737	4.565	.009082	-.00119
32	6.41790	6.30000	8.60560	4.111	.008081	-.00059
33	7.32001	7.20000	8.66715	3.708	.007612	.00025
34	8.22171	8.10000	8.72253	3.341	.006913	-.00020
35	9.12309	9.00000	8.77226	2.999	.006395	-.00038
36	10.92505	10.80000	8.85617	2.350	.006045	-.00011
37	12.72620	12.60000	8.92033	1.730	.005886	-.00004
38	14.52677	14.40000	8.96536	1.128	.005806	.00007
39	16.32697	16.20000	8.99163	.548	.005596	.00024
40	18.12700	18.00000	9.00000	.000	.004952	-.00036
41	18.12700	18.00000	9.00000	.000	.000000	.00000
42	27.62700	27.50000	9.00000	.000	.000000	.00000

IDENT= NASA INLET CONFIGURATION NO. 8

B O U N D A R Y C O O R D I N A T E S. BDY=CLEX CHN=EXT UPPER= F BL= T

DOUBLE POINTS WITH ANGLE DIFFERENCES LESS THAN .010 ARE ELIMINATED (DBLPTS= .010).

I	X.Z	Y.R	ANGD	CURV-	CURV+
1	.00000	7.68200	90.000	.0000	17.2095
2	.00191	7.69676	75.425	16.1600	15.5005
3	.00551	7.70704	66.085	14.1340	13.8217
4	.01163	7.71824	57.017	10.7423	11.0169
5	.02340	7.73314	47.103	7.0051	7.5860
6	.03606	7.74522	40.627	5.2668	5.3943
7	.07140	7.76992	30.349	2.8203	2.8129
8	.10804	7.78898	25.099	1.6094	1.4377
9	.14400	7.80473	22.362	.9940	.8288
10	.18000	7.81889	20.601	.7591	.7116
11	.27000	7.84974	17.511	.4208	.4638
12	.36000	7.87635	15.633	.2346	.2613
13	.45000	7.90051	14.505	.1610	.1395
14	.54000	7.92316	13.753	.1436	.1073
15	.63000	7.94468	13.120	.1313	.1221
16	.72000	7.96514	12.509	.1091	.1296
17	.81000	7.98460	11.927	.0908	.1144
18	.90000	8.00317	11.406	.0835	.0908
19	1.08000	8.03804	10.557	.0707	.0666
20	1.26000	8.07052	9.922	.0547	.0529
21	1.44000	8.10118	9.431	.0409	.0441
22	1.62000	8.13038	9.012	.0361	.0349
23	1.80000	8.15830	8.611	.0419	.0346
24	2.16000	8.21035	7.818	.0415	.0385
25	2.52000	8.25736	7.085	.0319	.0383
26	2.88000	8.29999	6.486	.0195	.0262
27	3.24000	8.33940	6.045	.0163	.0139
28	3.60000	8.37653	5.721	.0173	.0107
29	3.96000	8.41180	5.453	.0151	.0128
30	4.50000	8.46158	5.093	.0104	.0120
31	5.40000	8.53737	4.565	.0084	.0091
32	6.30000	8.60560	4.111	.0084	.0074
33	7.20000	8.66715	3.708	.0082	.0075
34	8.10000	8.72253	3.341	.0067	.0075
35	9.00000	8.77226	2.999	.0058	.0066
36	10.80000	8.85617	2.350	.0060	.0059
37	12.60000	8.92033	1.730	.0061	.0056
38	14.40000	8.96536	1.128	.0060	.0057
39	16.20000	8.99163	.548	.0055	.0058
40	18.00000	9.00000	.000	.0049	-.0000
41	27.50000	9.00000	.000	.0000	.0000

```
IDENT=  NASA INLET CONFIGURATION NO. 8

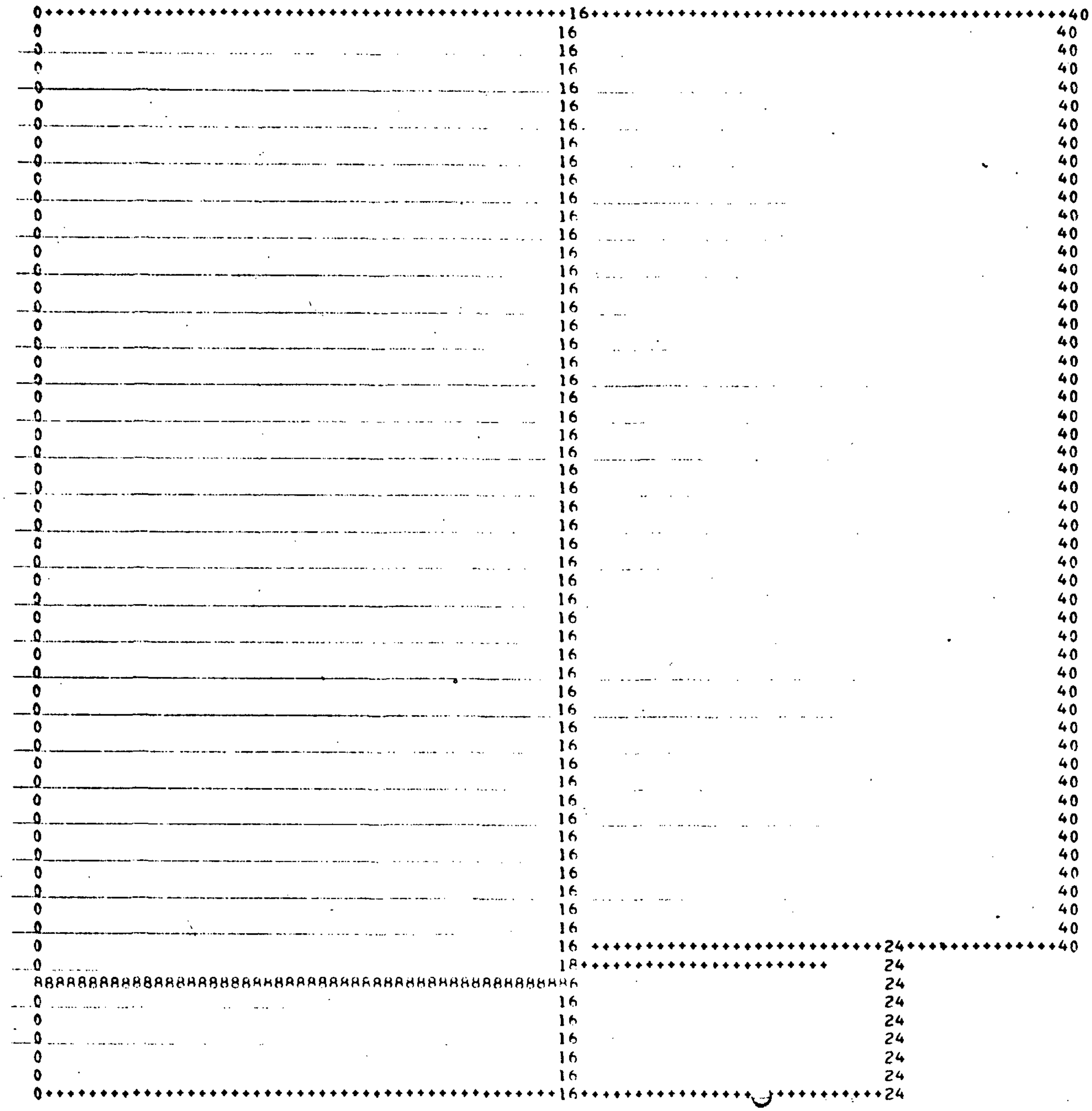
B O U N D A R Y  C O O R D I N A T E S.  BDY=FF        CHN=EXT        UPPER= T      BL= F

         I    X.Z         Y.R         ANGD      CURV-      CURV+
         1 -30.00000   60.00000       .000      .0000      .0000
         2  28.00000   60.00000       .000      .0000      .0000

 THE FAR FIELD INTERFACE BOUNDARY IS AT R=   60.000 BETWEEN Z=  -30.000 AND   28.000.   (BDY=FF    )

      *EXTENDED FAR FIELD BOUNDARY*
       Z=    -44.500    R=     60.000
       Z=     42.500    R=     60.276
```

XI1,XI2 GRID MAP



IDENT= NASA INLET CONFIGURATION NO. 8

SOLUTION HISTORY

REFINEMENT		+ INNER ITERS		+ MATRIX SOLUTION +		- - FLOW BALANCE ERROR			- - +	KUTTA ITERATION		
NREFIN	GRID PTS	INRCTR	NSSPTS	NSWEEPS	MAX-DS2	MAX-ES2	LIM-ES2	Z	R	TRAILING EDGE-XI2	FLOW RATE	FRACTIONAL FLOW ERROR
0	12	0	0	0	*0.000000	-.003837	2.545455	-29.666	6.919			
0	12	1	0	2	-.003837	-.008710	2.545455	-29.325	6.924			
1	50	0	0	0	*0.000000	.457530	1.095440	-.717	30.722			
1	50	1	0	11	-.314602	.086673	1.095440	27.416	60.207			
2	113	0	0	0	*0.000000	-.275352	.567289	-7.322	7.237			
2	113	1	0	16	-.181634	.031320	.567289	27.319	60.233			
3	178	0	0	0	*0.000000	-.211327	.284509	-3.648	7.285			
3	178	1	0	12	-.102556	.019829	.284509	-3.940	10.462			
4	232	0	0	0	*0.000000	-.148321	.176341	-1.811	7.373			
4	232	1	0	20	-.055688	.022829	.176341	-3.629	7.157			
5	336	0	0	0	*0.000000	-.361413	.135780	-.894	7.459			
5	336	1	0	27	-.056524	.030502	.135780	-2.706	7.212			
6	455	0	0	0	*0.000000	-.346075	.087705	-.373	6.973			
6	455	1	0	30	-.025230	-.127633	.087705	-.355	6.400			
6	455	2	0	31	-.006845	-.039335	.087705	-.333	5.824			
7	543	0	0	0	*0.000000	.116518	.063171	-.497	7.744			
7	543	1	0	36	.022962	-.047492	.063171	-.426	7.486			
8	580	0	0	0	*0.000000	-.183480	5.090909	-.426	7.486			
8	580	1	0	41	-.025762	.059239	5.090909	-.266	7.677			

*** THE INPUT GRID REFINEMENT CRITERIA HAVE NOT BEEN SATISFIED.

```
IDENT=  NASA INLET CONFIGURATION NO. 8

GENERAL INPUT-
     AXI    =        T                                     MACHO =    .8000
     RG     = 1716.20                                      TSO   =   518.69
     GAM    =  1.4000                                      PSO   =   14.696
     TTF    =    .000                                      PTO   =   22.402
     CHOTST=         T                                     TTO   =   585.08
     CG     =  32.174

STREAMLINE END CONDITIONS-
     NBCIN =         2        2
     ACF    =     .000     .000

CURVATURE CALCULATION FOR SUPERSONIC FLOW-
     SSFML =         1   (FORMULA NUMBER)
     SSEANG=      .000   (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)

SUBSONIC/SUPERSONIC BRANCH SELECTION-
     SSEF   =        F   (SUPERSONIC ENTERING FLOW, T OR F)
     SSDF   =        F   (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION, T OR F)

GRID SIZE CRITERIA-
     NGR/GR=       .00     7.00     8.50    10.00    20.00
     SGR    =     3.00     1.00     1.00     3.00    12.00

     NGZ/GZ=    -15.00    -7.00    -2.00     2.00     7.00    15.00
     SGZ    =    12.00     5.00     1.00     1.00     5.00    12.00

     VMG1   =  100.00                                 VMG2  =  100.00

     CRX    =     .375     .375     .125     .000     .000     .000

MEMORY UTILIZATION-
                             USED     AVAILABLE
     GRID POINTS              580        768
     TABLES                  1193       2200
     STREAMLINES               29        128

CONVERGENCE DATA-
     MAXREF=         8   (MAXIMUM REFINEMENTS)
     NREFIN=         8 - NUMBER OF REFINEMENTS
     INRCTR=         1 - NUMBER OF ITERATIONS IN LAST REFINEMENT

     TOLINR= 5.0E-02   (INNER ITERATION TOLERANCE ON S.L. MOVEMENT)
     TOLES2= 1.0E+00   (FINAL TOLERANCE ON S.L. MOVEMENT)
     TOLWF = 1.0E-03   (T.E. CLOSURE FRACTIONAL FLOW TOLERANCE)
     CLEN   =    5.091 - CHARACTERISTIC LENGTH BASED ON GRID SIZE CRITERIA
               5.1E+00 - ABSOLUTE TOLERANCE ON S.L. MOVEMENT (=TOLES2*CLEN)
     MAXES2= 5.9E-02 - LARGEST S.L. MOVEMENT ON LAST ITERATION

     DSIDMP=      .020   (STREAMWISE PT MOVEMENT DAMPING, =0 FOR NO DAMPING)
     DSIDP1=      .500   (ADDITIONAL STREAMWISE DAMPING ON FIRST PASS ONLY)
     NODENS=         0   (REFINEMENT LEVEL TO WHICH CONSTANT DENSITY IS ASSUMED)
     RHOC   =    1.000   RHOW   =   1.000   RHOCSS=  1.000   RHOWSS=  1.000   (CORRECTION EQ. DECEL. FACTORS)
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IDENT=  NASA INLET CONFIGURATION NO. 8

SPECIAL BOUNDARY OPTIONS-
     FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
     IADM   =        0   (=-1,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION)
     RHORAS=     .500    (ACCELERATION FACTOR, BASE LEVEL)
     RHOAMP=     .500    (ACCELERATION FACTOR, AMPLITUDE OF VARIATION)
     TOLRL = 1.0E-03     (TOLERANCE RELATIVE TO MAXDS2)

     HIGHLIGHT RADIUS=    7.682     HIGHLIGHT AREA= 185.395
     MAX. BODY RADIUS=    9.000     MAX. BODY AREA= 254.469
     MASS FLOW RATIO =     .809

CONTENTS OF CHANNEL TABLE-

     CHN    =  W2          WTFLOW=  1.0000E+15
     TTO    =*0000.00      PTO    =*000.000      TSO    =*0000.00     PSO    =*000.000
     MACHO  =*00.0000      AO     =  8.0930E-01  VAPY   =        T
     RG     =*0000.00      GAM    =*00.0000

CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-

               SPECIFIED     ADJUSTED       PT/PSO       TT/TSO
     W2          2.2122        2.2122      22.4016     585.0801
     EXT       164.5381      164.5381      22.4016     585.0801
```

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=W2 STREAMLINE COORDINATE. X12= .000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.31997	.00000	.000	.00000	1.002	.005	.657	.7978	-.0000	1.000	1.000
4.000	7.348	-21.97243	.00000	.000	.00000	1.010	.022	.663	.7900	-.0000	1.000	1.000
8.000	14.705	-14.61542	.00000	.000	.00000	1.024	.054	.672	.7757	-.0000	1.000	1.000
10.000	18.398	-10.92212	.00000	.000	.00000	1.041	.092	.683	.7583	-.0000	1.000	1.000
12.000	22.114	-7.20631	.00000	.000	.00000	1.072	.161	.703	.7273	-.0000	1.000	1.000
13.000	23.997	-5.32331	.00000	.000	.00000	1.100	.223	.721	.6992	-.0000	1.000	1.000
14.000	25.897	-3.42307	.00000	.000	.00000	1.131	.292	.742	.6671	-.0000	1.000	1.000
14.500	26.843	-2.47660	.00000	.000	.00000	1.146	.325	.752	.6518	-.0000	1.000	1.000
14.750	27.318	-2.00228	.00000	.000	.00000	1.152	.340	.756	.6452	-.0000	1.000	1.000
15.000	27.781	-1.53860	.00000	.000	.00000	1.160	.357	.761	.6371	-.0000	1.000	1.000
15.500	28.675	-.64529	.00000	.000	.00000	1.174	.387	.770	.6229	-.0000	1.000	1.000
15.750	29.072	-.24793	.00000	.000	.00000	1.162	.362	.762	.6350	-.0000	1.000	1.000
16.000	29.310	-.01027	.00000	.000	.00000	1.178	.398	.773	.6178	-.0000	1.000	1.000
16.250	29.763	.44291	.00000	.000	.00000	1.182	.407	.776	.6136	-.0000	1.000	1.000
16.500	30.380	1.06026	.00000	.000	.00000	1.186	.416	.778	.6093	-.0000	1.000	1.000
16.750	30.963	1.64331	.00000	.000	.00000	1.190	.423	.780	.6058	-.0000	1.000	1.000
17.000	31.530	2.20970	.00000	.000	.00000	1.193	.430	.782	.6027	-.0000	1.000	1.000
17.500	32.647	3.32697	.00000	.000	.00000	1.198	.442	.786	.5968	-.0000	1.000	1.000
18.000	33.766	4.44621	.00000	.000	.00000	1.204	.456	.790	.5902	-.0000	1.000	1.000
19.000	36.046	6.72593	.00000	.000	.00000	1.222	.495	.801	.5713	-.0000	1.000	1.000
20.000	38.351	9.03058	.00000	.000	.00000	1.244	.545	.816	.5465	-.0000	1.000	1.000
21.000	40.660	11.33983	.00000	.000	.00000	1.275	.615	.837	.5111	-.0000	1.000	1.000
22.000	42.903	13.58306	.00000	.000	.00000	1.304	.678	.855	.4779	-.0000	1.000	1.000
24.000	47.298	17.97833	.00000	.000	.00000	1.349	.779	.885	.4216	-.0000	1.000	1.000

TT/TTO = 1.000

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=W2 , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.32478	6.91380	.077	.00000	1.002	.005	.657	.7978	-.0000	.410	1.000
4.000	7.346	-21.97865	6.92485	.104	-.00012	1.010	.021	.662	.7903	-.0000	.408	1.000
8.000	14.692	-14.63257	6.94609	.264	-.00064	1.023	.051	.671	.7772	-.0002	.404	1.000
10.000	18.365	-10.95960	6.97099	.570	-.00227	1.037	.082	.680	.7631	-.0004	.400	1.000
12.000	22.038	-7.28695	7.02500	1.148	-.00323	1.061	.136	.696	.7384	-.0015	.391	1.000
13.000	23.875	-5.45102	7.07171	1.906	-.01117	1.079	.177	.708	.7200	-.0027	.383	1.000
14.000	25.711	-3.61628	7.15199	3.116	-.01187	1.108	.240	.727	.6912	-.0057	.369	1.000
14.500	26.630	-2.69979	7.20884	4.104	-.02568	1.126	.282	.739	.6722	-.0083	.358	1.000
14.750	27.089	-2.24205	7.24458	4.848	-.03081	1.142	.317	.749	.6556	-.0102	.352	1.000
15.000	27.548	-1.78464	7.28650	5.611	-.02742	1.158	.352	.759	.6396	-.0127	.345	1.000
15.250	28.007	-1.32830	7.33520	6.686	-.05422	1.173	.387	.770	.6231	-.0160	.336	1.000
15.500	28.466	-.87309	7.39499	8.361	-.07304	1.217	.485	.798	.5762	-.0207	.325	1.000
15.625	28.696	-.64626	7.43031	9.350	-.08099	1.246	.550	.818	.5442	-.0241	.318	1.000
15.750	28.925	-.42056	7.47222	12.326	-.36894	1.295	.658	.850	.4883	-.0287	.311	1.000
15.875	29.155	-.19890	7.53168	17.971	-.48562	1.379	.845	.904	.3817	-.0370	.300	1.000
16.000	29.385	.01508	7.61457	-15.248	2.93027	1.524	1.170	1.000	.0000	-.0526	.284	1.000

TT/TTO = 1.000

ADDITIVE DRAG = -.0526

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=W2 • STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
16.000	.000	.01508	7.51457	-15.248	2.93027	1.524	1.170	1.000	.0000	-.0526	.284	1.000
16.125	.277	.22498	7.43912	-24.012	-1.37578	1.232	.518	.808	.5600	-.0251	.317	1.000
16.187	.415	.35569	7.39401	-14.598	-.97685	1.140	.312	.748	.6580	-.0217	.325	1.000
16.250	.554	.49150	7.36714	-8.174	-.66970	1.074	.164	.704	.7258	-.0205	.330	1.000
16.375	.831	.76767	7.34790	-.803	-.07237	1.122	.272	.736	.6767	-.0197	.333	1.000
16.500	1.108	1.04466	7.34658	.209	-.05508	1.144	.321	.750	.6540	-.0197	.334	1.000
16.750	1.662	1.59859	7.35528	1.406	-.02033	1.168	.376	.766	.6284	-.0202	.332	1.000
17.000	2.216	2.15240	7.37021	1.500	.01443	1.186	.416	.778	.6093	-.0213	.329	1.000
17.500	3.324	3.26022	7.39124	1.001	-.00013	1.193	.431	.783	.6023	-.0229	.326	1.000
18.000	4.432	4.36807	7.41068	1.009	-.00013	1.197	.441	.785	.5976	-.0244	.322	1.000
19.000	6.648	6.58357	7.45829	2.079	-.01403	1.197	.441	.786	.5975	-.0283	.313	1.000
20.000	8.864	8.79650	7.57354	3.873	-.01317	1.229	.512	.806	.5629	-.0385	.292	1.000
21.000	11.080	11.00528	7.75207	5.279	-.00864	1.264	.590	.829	.5238	-.0571	.258	1.000
22.000	13.296	13.21053	7.97042	5.859	-.00049	1.304	.678	.855	.4776	-.0840	.216	1.000
24.000	17.728	17.62415	8.37429	4.034	.01127	1.352	.786	.887	.4172	-.1437	.134	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE. CHN=W2 (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	1975.6665
LOWER BOUNDARY PRESSURE FORCE	=	.0000
UPPER BOUNDARY PRESSURE FORCE	=	240.7089
SUM OF ABOVE		2216.3754
LEAVING MOMENTUM	=	2214.4417
ERROR	=	1.9337

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.32478	6.91380	.077	.00000	1.002	.005	.657	.7978	-.0000	.410	1.000
4.000	7.346	-21.97866	6.92485	.104	-.00012	1.010	.021	.662	.7903	.0000	.408	1.000
8.000	14.692	-14.63257	6.94609	.264	-.00064	1.023	.051	.671	.7772	.0002	.404	1.000
10.000	18.365	-10.95960	6.97099	.570	-.00227	1.037	.082	.680	.7631	.0004	.400	1.000
12.000	22.038	-7.28695	7.02500	1.148	-.00323	1.061	.136	.696	.7384	.0015	.391	1.000
13.000	23.875	-5.45102	7.07171	1.906	-.01117	1.079	.177	.708	.7200	.0027	.383	1.000
14.000	25.711	-3.61628	7.15199	3.116	-.01187	1.108	.240	.727	.6912	.0057	.369	1.000
14.500	26.630	-2.69979	7.20884	4.104	-.02568	1.126	.282	.739	.6722	.0083	.358	1.000
14.750	27.089	-2.24205	7.24458	4.848	-.03081	1.142	.317	.749	.6556	.0102	.352	1.000
15.000	27.548	-1.78484	7.28650	5.611	-.02742	1.158	.352	.759	.6396	.0127	.345	1.000
15.250	28.007	-1.32830	7.33520	6.686	-.05422	1.173	.387	.770	.6231	.0160	.336	1.000
15.500	28.466	-.87309	7.39499	8.361	-.07304	1.217	.485	.798	.5762	.0207	.325	1.000
15.625	28.696	-.64626	7.43031	9.350	-.08099	1.246	.550	.818	.5442	.0241	.318	1.000
15.750	28.925	-.42056	7.47222	12.326	-.36894	1.295	.658	.850	.4883	.0287	.311	1.000
15.875	29.155	-.19890	7.53168	17.971	-.48562	1.379	.845	.904	.3817	.0370	.300	1.000
16.000	29.385	.01508	7.61457	71.143	-4.34465	1.524	1.170	1.000	.0000	.0526	.284	1.000

TT/TTO = 1.000

ADDITIVE DRAG = .0526

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 8.000.

XI1	SW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
16.000	.000	.01508	7.61457	71.143	-4.34465	1.524	1.170	1.000	.0000	.0526	.284	1.000
16.094	.109	.01217	7.71907	56.393	10.83817	.398	-1.344	.261	1.5295	.0509	.264	1.000
16.187	.217	.09702	7.78368	26.354	1.97040	.690	-.692	.453	1.1274	.0383	.252	1.000
16.375	.433	.29973	7.85890	16.752	.38798	.772	-.510	.506	1.0361	.0296	.238	1.000
16.563	.650	.50857	7.91539	14.018	.14215	.837	-.363	.549	.9662	.0248	.227	1.000
16.750	.866	.71918	7.96496	12.514	.10923	.866	-.300	.568	.9367	.0215	.217	1.000
17.125	1.299	1.14352	8.04974	10.319	.06238	.881	-.266	.578	.9208	.0168	.200	1.000
17.500	1.731	1.57011	8.12242	9.120	.03832	.894	-.237	.586	.9078	.0132	.186	1.000
18.250	2.597	2.42675	8.24562	7.262	.03364	.906	-.210	.594	.8952	.0076	.161	1.000
19.000	3.462	3.28659	8.34432	6.007	.01439	.927	-.163	.608	.8736	.0038	.140	1.000
20.500	5.193	5.01002	8.50555	4.772	.00997	.934	-.147	.613	.8666	-.0014	.107	1.000
22.000	6.924	6.73606	8.63621	3.920	.00778	.944	-.125	.619	.8565	-.0051	.079	1.000
25.000	10.386	10.19253	8.83012	2.561	.00618	.945	-.122	.620	.8550	-.0103	.037	1.000
28.000	13.848	13.65241	8.94896	1.384	.00587	.949	-.114	.623	.8514	-.0134	.011	1.000
34.000	20.772	20.57603	9.00000	.000	-.00000	.984	-.035	.646	.8157	-.0142	.000	1.000
40.000	27.696	27.50000	9.00000	.000	.00000	.998	-.005	.654	.8024	-.0142	.000	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	.0151	.00000	.00000	.00000	0	.0000	.06447	.0000	.00000	.00480		.000000
2	.0122	.00022	.00051	.00260	55197	.0543	.00302	.1085	.00060	.00630		.000000
3	.0970	.00078	.00147	.00869	114640	.2479	.00408	.2168	.00137	.00677		.357150
4	.2997	.00148	.00266	.01630	225871	.5421	.00438	.4332	.00271	.00568		.226246
5	.5086	.00221	.00385	.02420	332540	.8846	.00397	.6496	.00382	.00469		.229857
6	.7192	.00290	.00480	.03057	438914	1.1918	.00379	.8659	.00474	.00402		.162801
7	1.1435	.00370	.00628	.04025	654357	1.6643	.00357	1.2987	.00629	.00333		.120890
8	1.5701	.00456	.00769	.04951	867869	2.1533	.00340	1.7314	.00762	.00309		.112454
9	2.4268	.00607	.01019	.06589	1294833	3.0742	.00318	2.5969	.01031	.00292		.125467
10	3.2866	.00775	.01285	.08383	1709576	4.1434	.00300	3.4624	.01267	.00266		.123521
11	5.0100	.01026	.01696	.11089	2555695	5.8731	.00280	5.1934	.01704	.00236		.084785
12	6.7361	.01278	.02102	.13801	3390516	7.7111	.00266	6.9244	.02084	.00211		.076545
13	10.1925	.01694	.02785	.18289	5081882	10.9618	.00248	10.3864	.02759	.00209		.043521
14	13.6524	.02105	.03455	.22723	6763271	14.3722	.00235	13.8484	.03532	.00221		.099804
15	20.5760	.03157	.05092	.33948	9947414	23.6223	.00215	20.7724	.05039	.00212		.129604
16	27.5000	.04033	.06463	.43298	13157468	31.9535	.00207	27.6963	.06463	.00200		.107491

TOTAL FRICTION DRAG= 27.12682

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 16.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.50524	60.02576	.168	.00000	1.002	.005	.657	.7978	-.0000	-43.483	1.000
4.000	7.313	-22.19202	60.04789	.184	-.00007	1.002	.004	.657	.7983	-.0001	-43.515	1.000
8.000	14.531	-14.97407	60.07294	.214	-.00008	1.001	.003	.657	.7986	-.0003	-43.553	1.000
10.000	18.082	-11.42365	60.08671	.230	-.00008	1.001	.003	.657	.7988	-.0003	-43.573	1.000
12.000	21.555	-7.95071	60.10109	.244	-.00007	1.001	.002	.657	.7991	-.0004	-43.594	1.000
14.000	24.873	-4.63238	60.11556	.255	-.00005	1.001	.001	.656	.7994	-.0004	-43.616	1.000
16.000	27.651	-1.85481	60.12808	.261	-.00003	1.000	.001	.656	.7997	-.0004	-43.634	1.000
19.000	31.585	2.07905	60.14613	.264	.00000	1.000	-.000	.656	.8001	-.0004	-43.661	1.000
22.000	35.307	5.80146	60.16319	.260	.00003	1.000	-.001	.656	.8005	-.0004	-43.687	1.000
25.000	38.990	9.48471	60.17965	.251	.00005	.999	-.002	.655	.8009	-.0004	-43.711	1.000
28.000	42.649	13.14370	60.19534	.240	.00006	.999	-.003	.655	.8012	-.0003	-43.734	1.000
34.000	49.817	20.31157	60.22372	.213	.00008	.998	-.004	.655	.8017	-.0002	-43.777	1.000
40.000	56.794	27.28872	60.24836	.197	.00000	.998	-.005	.654	.8024	-.0000	-43.813	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE. CHN=EXT (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=146945.1588
LOWER BOUNDARY PRESSURE FORCE =	23.7939
UPPER BOUNDARY PRESSURE FORCE =	.0693
SUM OF ABOVE	146969.0219
LEAVING MOMENTUM	=146944.6740
ERROR	= 24.3479

```
          EXECUTING PROGM=STC
         TAPIN= T      TAPOT= T


THE FAR FIELD INTERFACE BOUNDARY IS AT R=   60.000 BETWEEN Z=  -30.000 AND   28.000.   (WDY=FF     )

     *EXTENDED FAR FIELD BOUNDARY*
        Z=   -44.500   R=     60.000
        Z=    42.500   R=     60.276
```

IDENT= NASA INLET CONFIGURATION NO. 8

SOLUTION HISTORY

REFINEMENT		INNER ITERS		MATRIX SOLUTION		FLOW BALANCE ERROR				KUTTA	ITERATION	
NREFIN	GRID PTS	INRCTR	NSSPTS	NSWEEPS	MAX-DS2	MAX-ES2	LIM-ES2	Z	R	TRAILING EDGE-XI2	FLOW RATE	FRACTIONAL FLOW ERROR
8	580	0	1	0	*0.000000	.057184	5.090909	-.266	7.677			
8	580	1	1	17	.055598	.028608	5.090909	-1.056	13.070			

*** THE INPUT GRID REFINEMENT CRITERIA HAVE NOT BEEN SATISFIED.

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IDENT=  NASA INLET CONFIGURATION NO. 8

GENERAL INPUT-
      AXI     =         T                            MACHO =    .8000
      RG      = 1716.20                              TSO   =   518.69
      GAM     =   1.4000                             PSO   =   14.696
      TTE     =     .000                             PTO   =   22.402
      CHOTST=           T                            TTO   =   585.08
      CG      =   32.174

STREAMLINE END CONDITIONS-
      NRCIN =          2        2
      ACF   =       .000     .000

CURVATURE CALCULATION FOR SUPERSONIC FLOW-
      SSFML =           1    (FORMULA NUMBER)
      SSEANG=       .000    (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)

SUBSONIC/SUPERSONIC BRANCH SELECTION-
      SSEF  =          F    (SUPERSONIC ENTERING FLOW, T OR F)
      SSDF  =          F    (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION, T OR F)

GRID SIZE CRITERIA-
      NGR/GR=       .00      7.00     8.50    10.00    20.00
      SGR   =      3.00      1.00     1.00     3.00    12.00

      NGZ/GZ=    -15.00     -7.00    -2.00     2.00     7.00    15.00
      SGZ   =     12.00      5.00     1.00     1.00     5.00    12.00

      VMG1  =    100.00                              VMG2  =   100.00

      CRX   =      .375      .375     .125     .000     .000     .000

MEMORY UTILIZATION-
                         USED     AVAILABLE
      GRID POINTS         580        768
      TABLES             1247       2200
      STREAMLINES          29        128

CONVERGENCE DATA-
      MAXREF=          8    (MAXIMUM REFINEMENTS)
      NREFIN=          8 -  NUMBER OF REFINEMENTS
      INRCTR=          1 -  NUMBER OF ITERATIONS IN LAST REFINEMENT

      TOLINR= 5.0E-02    (INNER ITERATION TOLERANCE ON S.L. MOVEMENT)
      TOLES2= 1.0E+00    (FINAL TOLERANCE ON S.L. MOVEMENT)
      TOLWF = 1.0E-03    (T.E. CLOSURE FRACTIONAL FLOW TOLERANCE)
      CLEN  =    5.091 -  CHARACTERISTIC LENGTH BASED ON GRID SIZE CRITERIA
               5.1E+00 -  ABSOLUTE TOLERANCE ON S.L. MOVEMENT (=TOLES2*CLEN)
      MAXES2= 2.9E-02 -  LARGEST S.L. MOVEMENT ON LAST ITERATION

      DSIDMP=     .020    (STREAMWISE PT MOVEMENT DAMPING, =0 FOR NO DAMPING)
      DSIDP1=     .500    (ADDITIONAL STREAMWISE DAMPING ON FIRST PASS ONLY)
      NODENS=        0    (REFINEMENT LEVEL TO WHICH CONSTANT DENSITY IS ASSUMED)
      RHOC  =    1.000    RHOW  =   1.000    RHOCSS=  1.000    RHOWSS=  1.000    (CORRECTION EQ. DECEL. FACTORS)
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IDENT=  NASA INLET CONFIGURATION NO. 8

SPECIAL BOUNDARY OPTIONS-
     FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
     IADM  =        0   (=-1,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION)
     RHORAS=     .500   (ACCELERATION FACTOR, BASE LEVEL)
     RHOAMP=     .500   (ACCELERATION FACTOR, AMPLITUDE OF VARIATION)
     TOLRL = 1.0E-03    (TOLERANCE RELATIVE TO MAXDS2)

     HIGHLIGHT RADIUS=   7.682     HIGHLIGHT AREA= 185.395
     MAX. BODY RADIUS=   9.000     MAX. BODY AREA= 254.469
     MASS FLOW RATIO =    .809

CONTENTS OF CHANNEL TABLE-

     CHN    =  W2          WTFLOW=  1.0000E+15
     TTO    =*0000.00      PTO    =*000.000     TSO    =*0000.00     PSO    =*000.000
     MACHO  =*00.0000      AO     =  8.0930E-01 VARY   =        T
     RG     =*0000.00      GAM    =*00.0000

CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-

                 SPECIFIED      ADJUSTED       PT/PSO       TT/TSO
     W2             2.2122        2.2122      22.4016     585.0801
     EXT          164.5381      164.5381      22.4016     585.0801
```

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=W2 STREAMLINE COORDINATE, XI2= .000.

XIJ	SIW	XW.ZW	YW.RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.31999	.00000	.000	.00000	1.002	.005	.657	.7978	-.0000	1.000	1.000
4.000	7.347	-21.97267	.00000	.000	.00000	1.010	.022	.663	.7899	-.0000	1.000	1.000
8.000	14.704	-14.61591	.00000	.000	.00000	1.024	.054	.672	.7755	-.0000	1.000	1.000
10.000	18.397	-10.92285	.00000	.000	.00000	1.042	.093	.683	.7578	-.0000	1.000	1.000
12.000	22.113	-7.20724	.00000	.000	.00000	1.073	.162	.704	.7266	-.0000	1.000	1.000
13.000	23.995	-5.32495	.00000	.000	.00000	1.101	.225	.722	.6983	-.0000	1.000	1.000
14.000	25.895	-3.42484	.00000	.000	.00000	1.132	.295	.743	.6659	-.0000	1.000	1.000
14.500	26.841	-2.47900	.00000	.000	.00000	1.147	.329	.753	.6502	-.0000	1.000	1.000
14.750	27.315	-2.00509	.00000	.000	.00000	1.155	.346	.758	.6423	-.0000	1.000	1.000
15.000	27.778	-1.54219	.00000	.000	.00000	1.163	.364	.763	.6336	-.0000	1.000	1.000
15.500	28.669	-.65119	.00000	.000	.00000	1.176	.393	.772	.6202	-.0000	1.000	1.000
15.750	29.071	-.24931	.00000	.000	.00000	1.183	.409	.776	.6124	-.0000	1.000	1.000
16.000	29.310	-.00981	.00000	.000	.00000	1.178	.398	.773	.6178	-.0000	1.000	1.000
16.250	29.769	.44859	.00000	.000	.00000	1.182	.406	.775	.6139	-.0000	1.000	1.000
16.500	30.384	1.06362	.00000	.000	.00000	1.186	.415	.778	.6099	-.0000	1.000	1.000
16.750	30.965	1.64482	.00000	.000	.00000	1.189	.422	.780	.6063	-.0000	1.000	1.000
17.000	31.530	2.21027	.00000	.000	.00000	1.192	.429	.782	.6032	-.0000	1.000	1.000
17.500	32.646	3.32645	.00000	.000	.00000	1.198	.442	.786	.5971	-.0000	1.000	1.000
18.000	33.765	4.44539	.00000	.000	.00000	1.204	.456	.790	.5903	-.0000	1.000	1.000
19.000	36.045	6.72507	.00000	.000	.00000	1.222	.495	.801	.5713	-.0000	1.000	1.000
20.000	38.350	9.02994	.00000	.000	.00000	1.244	.545	.816	.5465	-.0000	1.000	1.000
21.000	40.659	11.33921	.00000	.000	.00000	1.276	.615	.837	.5111	-.0000	1.000	1.000
22.000	42.903	13.58262	.00000	.000	.00000	1.304	.678	.855	.4779	-.0000	1.000	1.000
24.000	47.298	17.97832	.00000	.000	.00000	1.349	.779	.885	.4216	-.0000	1.000	1.000

TT/TTO = 1.000

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=W2 . STREAMLINE COORDINATE. XI2= 8.000.

XI1	SIW	XW.ZW	YW.RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	COPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.32478	6.91380	.077	.00000	1.002	.005	.657	.7978	-.0000	.410	1.000
4.000	7.346	-21.97890	6.92481	.103	-.00012	1.010	.022	.662	.7902	-.0000	.408	1.000
8.000	14.692	-14.63304	6.94600	.263	-.00064	1.023	.051	.671	.7770	-.0002	.404	1.000
10.000	18.365	-10.96018	6.97082	.568	-.00226	1.037	.083	.680	.7626	-.0004	.400	1.000
12.000	22.038	-7.28765	7.02462	1.144	-.00321	1.062	.138	.697	.7376	-.0015	.391	1.000
13.000	23.874	-5.45178	7.07115	1.899	-.01113	1.080	.179	.709	.7189	-.0028	.383	1.000
14.000	25.711	-3.61708	7.15117	3.108	-.01185	1.109	.244	.728	.6896	-.0057	.369	1.000
14.500	26.629	-2.70062	7.20795	4.107	-.02612	1.128	.287	.740	.6698	-.0084	.359	1.000
14.750	27.088	-2.24290	7.24378	4.872	-.03204	1.146	.326	.752	.6518	-.0104	.352	1.000
15.000	27.547	-1.78573	7.28600	5.665	-.02822	1.162	.363	.763	.6345	-.0130	.345	1.000
15.250	28.006	-1.32929	7.33538	6.822	-.05982	1.177	.394	.772	.6195	-.0163	.336	1.000
15.500	28.465	-.87433	7.39692	8.679	-.08131	1.224	.499	.803	.5692	-.0213	.325	1.000
15.625	28.695	-.64773	7.43360	9.692	-.07257	1.247	.551	.818	.5434	-.0249	.318	1.000
15.750	28.924	-.42223	7.47647	12.442	-.34609	1.298	.665	.852	.4848	-.0297	.310	1.000
15.875	29.154	-.20054	7.53568	17.702	-.45090	1.383	.856	.908	.3747	-.0380	.299	1.000
16.000	29.384	.01413	7.61670	-15.666	2.83635	1.524	1.170	1.000	.0000	-.0534	.284	1.000

TT/TTO = 1.000

ADDITIVE DRAG = -.0534

IDENT= NASA INLET CONFIGURATION NO. 6

UPPER BOUNDARY TO CHN=W2 STREAMLINE COORDINATE, XI2= 8.000,

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
16.000	.000	.01413	7.61670	-15.666	2.83635	1.524	1.170	1.000	.0000	-.0534	.284	1.000
16.125	.277	.22331	7.43986	-24.158	-1.38017	1.228	.510	.806	.5640	-.0257	.317	1.000
16.187	.416	.35396	7.39446	-14.699	-.98243	1.126	.281	.739	.6723	-.0225	.325	1.000
16.250	.554	.48974	7.36739	-8.242	-.67317	1.080	.179	.709	.7192	-.0213	.330	1.000
16.375	.831	.76591	7.34793	-.811	-.07248	1.120	.268	.735	.6785	-.0205	.333	1.000
16.500	1.108	1.04293	7.34657	.203	-.05519	1.146	.326	.752	.6518	-.0205	.334	1.000
16.750	1.662	1.59693	7.35524	1.404	-.02044	1.169	.377	.767	.6276	-.0210	.332	1.000
17.000	2.216	2.15079	7.37017	1.501	.01433	1.187	.417	.779	.6089	-.0221	.329	1.000
17.500	3.324	3.25872	7.39122	1.001	-.00013	1.193	.431	.783	.6021	-.0237	.326	1.000
18.000	4.433	4.36669	7.41065	1.009	-.00013	1.197	.441	.786	.5975	-.0253	.322	1.000
19.000	6.649	6.58242	7.45825	2.079	-.01403	1.197	.441	.786	.5975	-.0291	.313	1.000
20.000	8.865	8.79558	7.57348	3.872	-.01317	1.229	.512	.806	.5629	-.0393	.292	1.000
21.000	11.081	11.00459	7.75200	5.278	-.00865	1.264	.590	.829	.5238	-.0579	.258	1.000
22.000	13.298	13.21007	7.97038	5.859	-.00050	1.304	.679	.855	.4776	-.0848	.216	1.000
24.000	17.730	17.62415	8.37429	4.034	.01127	1.352	.786	.887	.4172	-.1445	.134	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=W2 (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	1975.6666
LOWER BOUNDARY PRESSURE FORCE	=	.0000
UPPER BOUNDARY PRESSURE FORCE	=	242.0989
SUM OF ABOVE		2217.7655
LEAVING MOMENTUM	=	2214.4419
ERROR	=	3.3235

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW.ZW	YW.PW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.32478	6.91380	.077	.00000	1.002	.005	.657	.7978	-.0000	.410	1.000
4.000	7.346	-21.97890	6.92481	.193	-.00012	1.010	.022	.662	.7902	.0000	.408	1.000
8.000	14.692	-14.63304	6.94600	.263	-.00064	1.023	.051	.671	.7770	.0002	.404	1.000
10.000	18.365	-10.96018	6.97082	.568	-.00226	1.037	.083	.680	.7626	.0004	.400	1.000
12.000	22.038	-7.28765	7.02462	1.144	-.00321	1.062	.138	.697	.7376	.0015	.391	1.000
13.000	23.874	-5.45178	7.07115	1.849	-.01113	1.080	.179	.709	.7189	.0028	.383	1.000
14.000	25.711	-3.61708	7.15117	3.108	-.01185	1.109	.244	.728	.6896	.0057	.369	1.000
14.500	26.629	-2.70062	7.20795	4.107	-.02612	1.128	.287	.740	.6698	.0084	.359	1.000
14.750	27.088	-2.24290	7.24378	4.872	-.03204	1.146	.326	.752	.6518	.0104	.352	1.000
15.000	27.547	-1.78573	7.28600	5.665	-.02822	1.162	.363	.763	.6345	.0130	.345	1.000
15.250	28.006	-1.32929	7.33538	6.822	-.05982	1.177	.394	.772	.6195	.0163	.336	1.000
15.500	28.465	-.87433	7.39692	8.679	-.08131	1.224	.499	.803	.5692	.0213	.325	1.000
15.625	28.695	-.64773	7.43360	9.692	-.07257	1.247	.551	.818	.5434	.0249	.318	1.000
15.750	28.924	-.42223	7.47647	12.442	-.34609	1.298	.665	.852	.4848	.0297	.310	1.000
15.875	29.154	-.20054	7.53568	17.702	-.45090	1.383	.856	.908	.3747	.0380	.299	1.000
15.000	29.384	.01413	7.61670	72.489	-4.53968	1.524	1.170	1.000	.0000	.0534	.284	1.000

TT/TTO = 1.000

ADDITIVE DRAG = .0534

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
16.000	.000	.01413	7.61670	72.489	-4.53968	1.524	1.170	1.000	.0000	.0534	.284	1.000
16.094	.108	.01195	7.71914	56.738	10.84952	.422	-1.289	.277	1.4882	.0522	.264	1.000
16.187	.216	.09642	7.78436	26.751	1.97723	.654	-.771	.429	1.1688	.0393	.252	1.000
16.375	.433	.29861	7.86094	17.108	.38913	.711	-.645	.466	1.1035	.0289	.237	1.000
16.563	.649	.50717	7.91861	14.309	.14213	.857	-.320	.562	.9458	.0234	.226	1.000
16.750	.866	.71758	7.96916	12.761	.10932	.873	-.285	.572	.9296	.0205	.216	1.000
17.125	1.298	1.14167	8.05554	10.519	.06242	.883	-.261	.579	.9186	.0158	.199	1.000
17.500	1.731	1.56809	8.12959	9.301	.03835	.896	-.233	.588	.9057	.0121	.184	1.000
18.250	2.597	2.42448	8.25551	7.432	.03366	.907	-.207	.595	.8941	.0065	.159	1.000
19.000	3.463	3.28418	8.35662	6.161	.01438	.928	-.162	.609	.8732	.0027	.138	1.000
20.500	5.194	5.00747	8.52225	4.908	.00997	.934	-.147	.613	.8666	-.0026	.103	1.000
22.000	6.925	6.73348	8.65677	4.042	.00778	.944	-.125	.619	.8566	-.0065	.075	1.000
25.000	10.388	10.19012	8.85749	2.682	.00618	.946	-.121	.620	.8548	-.0118	.031	1.000
28.000	13.850	13.65027	8.98408	1.511	.00587	.949	-.115	.622	.8518	-.0151	.004	1.000
34.000	20.775	20.57484	9.05024	.121	-.00000	.984	-.036	.645	.8162	-.0162	-.011	1.000
40.000	27.700	27.49987	9.06448	.114	.00000	.997	-.006	.654	.8026	-.0163	-.014	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	.0141	.00000	.00000	.00000	0	.0000	.09157	.0000	.00000	.00505		.000000
2	.0120	.00022	.00050	.00259	55569	.0541	.00309	.1082	.00058	.00564		.000000
3	.0964	.00071	.00138	.00803	114745	.2247	.00448	.2164	.00122	.00625		.273698
4	.2986	.00133	.00249	.01487	228222	.4848	.00470	.4328	.00271	.00640		.228290
5	.5072	.00243	.00417	.02646	330128	.9878	.00361	.6492	.00399	.00520		.314752
6	.7176	.00294	.00501	.03198	437608	1.2496	.00376	.8656	.00496	.00413		.123591
7	1.1417	.00379	.00642	.04118	653665	1.7123	.00355	1.2984	.00644	.00323		.109423
8	1.5681	.00464	.00782	.05041	867030	2.2019	.00338	1.7313	.00775	.00304		.110456
9	2.4245	.00614	.01029	.06660	1294178	3.1151	.00317	2.5969	.01042	.00289		.122218
10	3.2842	.00780	.01294	.08438	1709258	4.1775	.00299	3.4625	.01276	.00263		.121314
11	5.0075	.01029	.01701	.11125	2555831	5.8974	.00280	5.1938	.01710	.00235		.083592
12	6.7335	.01280	.02107	.13829	3390891	7.7308	.00266	6.9251	.02089	.00211		.076884
13	10.1901	.01696	.02789	.18317	5081824	10.9824	.00247	10.3876	.02761	.00208		.042094
14	13.6503	.02103	.03451	.22697	6765445	14.3525	.00235	13.8501	.03529	.00220		.098250
15	20.5748	.03149	.05080	.33857	9952001	23.5447	.00215	20.7752	.05027	.00211		.130290
16	27.4999	.04022	.06445	.43179	13161642	31.8449	.00207	27.7002	.06445	.00199		.109186

TOTAL FRICTION DRAG= 27.22329

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 16.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.50476	60.02573	.168	-.00000	1.002	.005	.657	.7978	-.0000	-43.483	1.000
4.000	7.313	-22.19188	60.04783	.183	-.00007	1.002	.004	.657	.7983	-.0001	-43.515	1.000
8.000	14.530	-14.97507	60.07289	.215	-.00008	1.001	.003	.657	.7985	-.0003	-43.552	1.000
10.000	18.079	-11.42592	60.08674	.232	-.00008	1.001	.003	.657	.7987	-.0003	-43.573	1.000
12.000	21.549	-7.95553	60.10129	.248	-.00008	1.001	.002	.657	.7990	-.0004	-43.595	1.000
14.000	24.863	-4.64161	60.11603	.261	-.00007	1.001	.002	.656	.7993	-.0004	-43.617	1.000
16.000	27.635	-1.87043	60.12888	.269	-.00003	1.000	.001	.656	.7996	-.0005	-43.636	1.000
19.000	31.547	2.04250	60.14741	.273	-.00001	1.000	-.000	.656	.8001	-.0005	-43.663	1.000
22.000	35.272	5.76684	60.16511	.270	.00003	.999	-.001	.656	.8005	-.0004	-43.689	1.000
25.000	38.956	9.45047	60.18224	.262	.00005	.999	-.002	.655	.8010	-.0004	-43.715	1.000
28.000	42.615	13.10998	60.19857	.249	.00007	.999	-.003	.655	.8013	-.0003	-43.739	1.000
34.000	49.786	20.28124	60.22763	.214	.00009	.998	-.004	.655	.8019	-.0002	-43.782	1.000
40.000	56.766	27.26077	60.25222	.196	.00000	.997	-.006	.654	.8026	-.0000	-43.819	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE. CHN=EXT (AXIAL FORCES ONLY)

ENTERING MOMENTUM =146945.1664
LOWER BOUNDARY PRESSURE FORCE = 27.3229
UPPER BOUNDARY PRESSURE FORCE = .0134
SUM OF ABOVE 146972.5027
LEAVING MOMENTUM =146944.4811
ERROR = 28.0217

```
EXECUTING PROGM=STC
TAPIN= T     TAPOT= F

THE FAR FIELD INTERFACE BOUNDARY IS AT R=   60.000 BETWEEN Z=  -30.000 AND   28.000.   (BDY=FF    )

     *EXTENDED FAR FIELD BOUNDARY*
       Z=   -44.500   R=    60.000
       Z=    42.500   R=    60.286
```

IDENT= NASA INLET CONFIGURATION NO. 8

SOLUTION HISTORY

REFINEMENT		INNER ITERS		MATRIX	SOLUTION	FLOW BALANCE ERROR				KUTTA ITERATION		
NREFIN	GRID PTS	INRCTR	NSSPTS	NSWEEPS	MAX-DS2	MAX-ES2	LIM-ES2	Z	R	TRAILING EDGE-XI2	FLOW RATE	FRACTIONAL FLOW ERROR
8	580	0	1	0	*0.000000	.029429	.005091	-1.057	13.070			
8	580	1	2	91	.005542	.017287	.005091	-.423	7.479			
8	580	2	1	64	-.002826	.020954	.005091	-.422	7.478			
8	580	3	2	24	-.002557	.010722	.005091	-.422	7.478			
8	580	4	1	16	.002831	.010693	.005091	-.422	7.478			
8	580	5	2	22	-.001751	.004534	.005091	-.422	7.477			

*** THE INPUT GRID REFINEMENT CRITERIA HAVE NOT BEEN SATISFIED.

```
IDENT=  NASA INLET CONFIGURATION NO. 8

GENERAL INPUT-
      AXT    =         T                                      MACHO =   .8000
      RG     = 1716.20                                        TSO   =  518.69
      GAM    =  1.4000                                        PSO   =  14.696
      TTE    =    .000                                        PTO   =  22.402
      CHOTST=          T                                      TTO   =  585.08
      CG     =  32.174

STREAMLINE END CONDITIONS-
      NBCIN  =         2        2
      ACF    =      .000     .000

CURVATURE CALCULATION FOR SUPERSONIC FLOW-
      SSFML  =         1   (FORMULA NUMBER)
      SSEANG=       .000   (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)

SUBSONIC/SUPERSONIC BRANCH SELECTION-
      SSEF   =         F   (SUPERSONIC ENTERING FLOW, T OR F)
      SSDF   =         F   (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION, T OR F)

GRID SIZE CRITERIA-
      NGR/GR=        .00      7.00     8.50    10.00    20.00
      SGP    =      3.00      1.00     1.00     3.00    12.00

      NGZ/GZ=     -15.00     -7.00    -2.00     2.00     7.00    15.00
      SGZ    =     12.00      5.00     1.00     1.00     5.00    12.00

      VMG1   =    100.00                                 VMG2  =  100.00

      CPX    =      .375      .375     .125     .000     .000     .000

MEMORY UTILIZATION-
                               USED      AVAILABLE
      GRID POINTS               580        768
      TABLES                   1247       2200
      STREAMLINES                29        128

CONVERGENCE DATA-
      MAXREF=          8   (MAXIMUM REFINEMENTS)
      NREFIN=          8 - NUMBER OF REFINEMENTS
      INRCTR=          5 - NUMBER OF ITERATIONS IN LAST REFINEMENT

      TOLINR= 5.0E-02   (INNER ITERATION TOLERANCE ON S.L. MOVEMENT)
      TOLES2= 1.0E-03   (FINAL TOLERANCE ON S.L. MOVEMENT)
      TOLWF = 1.0E-03   (T.E. CLOSURE FRACTIONAL FLOW TOLERANCE)
      CLEN  =    5.091 - CHARACTERISTIC LENGTH BASED ON GRID SIZE CRITERIA
                5.1E-03 - ABSOLUTE TOLERANCE ON S.L. MOVEMENT (=TOLES2*CLEN)
      MAXES2= 4.5E-03 - LARGEST S.L. MOVEMENT ON LAST ITERATION

      DS1DMP=     .020   (STREAMWISE PT MOVEMENT DAMPING, =0 FOR NO DAMPING)
      DS1DP1=     .500   (ADDITIONAL STREAMWISE DAMPING ON FIRST PASS ONLY)
      NODENS=        0   (REFINEMENT LEVEL TO WHICH CONSTANT DENSITY IS ASSUMED)
      RHOC   =   1.000   RHOW   =  1.000   RHOCSS=  1.000   RHOWSS=  1.000   (CORRECTION EQ. DECEL. FACTORS)
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IDENT=  NASA INLET CONFIGURATION NO. 8

SPECIAL BOUNDARY OPTIONS-
     FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
     IADM  =       0    (=-1,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION)
     RHOBAS=     .500   (ACCELERATION FACTOR, BASE LEVEL)
     RHOAMP=     .500   (ACCELERATION FACTOR, AMPLITUDE OF VARIATION)
     TOLRL = 1.0E-03    (TOLERANCE RELATIVE TO MAXDS2)

     HIGHLIGHT RADIUS=   7.682     HIGHLIGHT AREA= 185.395
     MAX. BODY RADIUS=   9.000     MAX. BODY AREA= 254.469
     MASS FLOW RATIO =    .809

CONTENTS OF CHANNEL TABLE-

     CHN   =  W2          WTFLOW=  1.0000E+15
     TTO   =*0000.00      PTO    =*000.000     TSO   =*0000.00     PSO   =*000.000
     MACHO =*00.0000      AO     =  8.0930E-01 VARY  =        T
     RG    =*0000.00      GAM    =*00.0000

CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-

                 SPECIFIED     ADJUSTED       PT/PSO      TT/TSO
     W2             2.2122       2.2122      22.4016    585.0801
     EXT          164.5381     164.5381      22.4016    585.0801
```

IDENT= NASA INLET CONFIGURATION NO. 8

STATION COORDINATE, XI1= .000** CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-29.31991	.00000	.000	.00000	1.002	.657	.887	.005	.7978	.000	1.000
2.000	.250	-29.32115	3.45694	.041	.00000	1.002	.657	.887	.005	.7978	37.543	1.000
4.000	.500	-29.32237	4.88885	.057	.00000	1.002	.657	.887	.005	.7978	75.087	1.000
8.000	1.000	-29.32478	6.91388	.079	.00000	1.002	.657	.887	.005	.7978	150.174	1.000
8.000	.013	-29.32478	6.91388	.079	.00000	1.002	.657	.887	.005	.7978	150.174	1.000
8.125	.029	-29.33021	10.16636	.115	.00000	1.002	.657	.887	.005	.7978	324.699	1.000
8.250	.044	-29.33563	12.60586	.137	.00000	1.002	.657	.887	.005	.7978	499.224	1.000
8.500	.075	-29.34570	16.43209	.169	.00000	1.002	.657	.887	.005	.7978	848.273	1.000
9.000	.137	-29.36493	22.18614	.206	.00000	1.002	.657	.887	.005	.7978	1546.370	1.000
10.000	.260	-29.39712	30.60469	.235	.00000	1.002	.657	.887	.005	.7978	2942.563	1.000
11.000	.383	-29.42456	37.16272	.237	.00000	1.002	.657	.887	.005	.7978	4338.753	1.000
12.000	.507	-29.44712	42.72575	.229	.00000	1.002	.657	.887	.005	.7978	5734.944	1.000
14.000	.753	-29.48295	52.09926	.203	.00000	1.002	.657	.887	.005	.7978	8527.329	1.000
16.000	1.000	-29.50895	60.02648	.172	.00000	1.002	.657	.887	.005	.7978	11319.719	1.000

SUM-VM*COS(PHI)*DFLOW = 148554.94
SUM-(P-PSO)*COS(PHI)*DA = 365.86
TOT AXIAL MOMENTUM FLUX = 148920.79

SUM-VM*SIN(PHI)*DFLOW = 534.30
SUM-(P-PSO)*SIN(PHI)*DA = 1.32
TOTAL Y-MOMENTUM FLUX = 535.61

STATION COORDINATE, XI1= 4.000 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-21.97252	.00000	.000	.00000	1.010	.663	.889	.023	.7898	.000	1.000
2.000	.250	-21.97408	3.46265	.052	-.00005	1.010	.663	.889	.023	.7898	37.668	1.000
4.000	.500	-21.97564	4.89689	.074	-.00008	1.010	.663	.889	.022	.7899	75.334	1.000
8.000	1.000	-21.97887	6.92512	.105	-.00013	1.010	.662	.889	.022	.7901	150.662	1.000
8.000	.013	-21.97887	6.92512	.105	-.00013	1.010	.662	.889	.022	.7901	150.662	1.000
8.125	.029	-21.98597	10.18243	.147	-.00016	1.009	.662	.889	.021	.7905	325.726	1.000
8.250	.044	-21.99300	12.62526	.181	-.00021	1.009	.662	.889	.020	.7909	500.761	1.000
8.500	.075	-22.00647	16.45599	.222	-.00026	1.008	.661	.889	.018	.7917	850.742	1.000
9.000	.137	-22.03126	22.21492	.263	-.00027	1.007	.661	.888	.015	.7931	1550.385	1.000
10.000	.260	-22.07136	30.63670	.282	-.00022	1.005	.659	.888	.011	.7950	2948.722	1.000
11.000	.383	-22.10344	37.19452	.272	-.00017	1.004	.659	.887	.009	.7961	4346.182	1.000
12.000	.507	-22.12897	42.75614	.255	-.00013	1.003	.658	.887	.007	.7968	5743.107	1.000
14.000	.753	-22.16814	52.12596	.220	-.00008	1.002	.658	.887	.005	.7977	8536.072	1.000
16.000	1.000	-22.19637	60.04914	.188	-.00007	1.002	.657	.887	.004	.7982	11328.265	1.000

IDENT= NASA INLET CONFIGURATION NO. 8

STATION COORDINATE, XI1= 8.000 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-14.61555	.00000	.000	.00000	1.025	.672	.893	.055	.7753	.000	1.000
1.000	.125	-14.61834	2.45638	.130	-.00000	1.025	.672	.893	.055	.7751	18.956	1.000
2.000	.250	-14.62080	3.47386	.148	-.00041	1.025	.672	.893	.055	.7752	37.912	1.000
4.000	.500	-14.62535	4.91258	.200	-.00051	1.024	.672	.893	.054	.7758	75.817	1.000
8.000	1.000	-14.63298	6.94664	.267	-.00064	1.023	.671	.892	.051	.7768	151.600	1.000
8.000	.013	-14.63298	6.94664	.267	-.00064	1.023	.671	.892	.051	.7768	151.600	1.000
8.063	.021	-14.64366	8.73393	.392	-.00000	1.023	.671	.892	.051	.7771	239.645	1.000
8.125	.029	-14.65373	10.71280	.385	-.00098	1.022	.671	.892	.049	.7777	327.672	1.000
8.250	.044	-14.67113	12.66117	.438	-.00102	1.020	.669	.892	.045	.7799	503.614	1.000
8.500	.075	-14.70232	16.49769	.483	-.00099	1.017	.667	.891	.037	.7833	855.059	1.000
9.000	.137	-14.75192	22.26025	.489	-.00082	1.012	.664	.890	.027	.7879	1556.717	1.000
10.000	.260	-14.81914	30.68066	.432	-.00050	1.007	.661	.888	.016	.7928	2957.190	1.000
11.000	.383	-14.86566	37.23457	.372	-.00031	1.005	.659	.888	.011	.7951	4355.545	1.000
12.000	.507	-14.89915	42.79243	.326	-.00022	1.004	.658	.887	.008	.7964	5752.859	1.000
14.000	.753	-14.94736	52.15621	.262	-.00012	1.002	.657	.887	.005	.7978	8545.981	1.000
16.000	1.000	-14.98067	60.07478	.220	-.00008	1.001	.657	.887	.003	.7985	11337.944	1.000

STATION COORDINATE, XI1= 10.000 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-10.92239	.00000	.000	.00000	1.042	.684	.897	.094	.7578	.000	1.000
1.000	.125	-10.92689	2.46645	.209	-.00075	1.041	.683	.897	.092	.7585	19.112	1.000
2.000	.250	-10.93172	3.48775	.307	-.00109	1.040	.683	.897	.090	.7593	38.216	1.000
4.000	.500	-10.93989	4.93137	.422	-.00158	1.039	.681	.896	.086	.7611	76.399	1.000
6.000	.750	-10.95057	6.03857	.620	-.00000	1.038	.681	.896	.084	.7619	114.556	1.000
8.000	1.000	-10.96012	6.97179	.575	-.00228	1.037	.680	.896	.083	.7626	152.700	1.000
8.000	.013	-10.96012	6.97179	.575	-.00228	1.037	.680	.896	.083	.7626	152.700	1.000
8.031	.017	-10.97103	7.91906	.748	-.00000	1.037	.680	.896	.082	.7632	197.014	1.000
8.063	.021	-10.98159	8.76425	.639	-.00235	1.036	.679	.895	.080	.7641	241.312	1.000
8.125	.029	-10.99766	10.24638	.706	-.00209	1.033	.678	.895	.073	.7669	329.830	1.000
8.250	.044	-11.03181	12.69808	.761	-.00209	1.029	.675	.894	.064	.7713	506.554	1.000
8.500	.075	-11.07934	16.53662	.779	-.00186	1.022	.670	.892	.049	.7779	859.099	1.000
9.000	.137	-11.16197	22.29708	.702	-.00126	1.014	.665	.890	.032	.7858	1561.874	1.000
10.000	.260	-11.24086	30.71103	.544	-.00060	1.007	.661	.888	.017	.7925	2963.048	1.000
11.000	.383	-11.30247	37.25975	.439	-.00035	1.005	.659	.888	.011	.7952	4361.439	1.000
12.000	.507	-11.33919	42.81408	.371	-.00023	1.003	.658	.887	.008	.7966	5758.681	1.000
14.000	.753	-11.39548	52.17324	.287	-.00012	1.002	.657	.887	.004	.7980	8551.561	1.000
16.000	1.000	-11.43161	60.08890	.236	-.00008	1.001	.657	.887	.003	.7987	11343.274	1.000

IDENT= NASA INLET CONFIGURATION NO. 8

STATION COORDINATE, XI1= 12.000 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-7.20641	.00000	.000	.00000	1.073	.704	.904	.162	.7266	.000	1.000
.500	.062	-7.21285	1.75931	.419	-.00000	1.074	.704	.905	.164	.7258	9.724	1.000
1.000	.125	-7.21890	2.48807	.504	-.00203	1.073	.704	.905	.163	.7263	19.448	1.000
2.000	.250	-7.22904	3.51806	.678	-.00241	1.071	.703	.904	.159	.7282	38.883	1.000
4.000	.500	-7.25034	4.97294	.926	-.00318	1.068	.701	.903	.152	.7314	77.692	1.000
6.000	.750	-7.26924	6.08768	1.052	-.00409	1.065	.698	.903	.144	.7348	116.427	1.000
8.000	1.000	-7.28758	7.02619	1.156	-.00324	1.062	.697	.902	.138	.7377	155.092	1.000
8.000	.013	-7.28758	7.02619	1.156	-.00324	1.062	.697	.902	.138	.7377	155.092	1.000
8.031	.017	-7.30737	7.97781	1.261	-.00489	1.059	.694	.901	.131	.7410	199.948	1.000
8.063	.021	-7.32708	8.82592	1.377	-.00470	1.055	.692	.900	.123	.7443	244.720	1.000
8.125	.029	-7.36365	10.31149	1.449	-.00504	1.049	.688	.899	.110	.7504	334.036	1.000
8.250	.044	-7.42700	12.76511	1.458	-.00466	1.039	.682	.896	.088	.7605	511.916	1.000
8.500	.075	-7.51850	16.59979	1.301	-.00326	1.026	.673	.893	.059	.7734	865.675	1.000
9.000	.137	-7.63676	22.34892	.995	-.00164	1.014	.666	.890	.032	.7854	1569.144	1.000
10.000	.260	-7.74976	30.74790	.666	-.00062	1.007	.660	.888	.015	.7932	2970.166	1.000
11.000	.383	-7.81952	37.28855	.508	-.00034	1.004	.659	.888	.009	.7958	4368.184	1.000
12.000	.507	-7.86244	42.83796	.415	-.00021	1.003	.658	.887	.006	.7971	5765.107	1.000
14.000	.753	-7.92283	52.19133	.310	-.00011	1.002	.657	.887	.004	.7984	8557.493	1.000
16.000	1.000	-7.96152	60.10366	.251	-.00007	1.001	.657	.887	.002	.7990	11348.845	1.000

STATION COORDINATE, XI1= 13.000 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-5.32510	.00000	.000	.00000	1.100	.722	.911	.224	.6984	.000	1.000
.500	.062	-5.33335	1.77430	.532	-.00210	1.099	.721	.911	.221	.6999	9.890	1.000
1.000	.125	-5.34160	2.50862	.763	-.00279	1.098	.720	.910	.218	.7013	19.771	1.000
2.000	.250	-5.35845	3.54584	1.067	-.00485	1.094	.718	.910	.211	.7047	39.499	1.000
3.000	.375	-5.37536	4.34074	1.473	.00000	1.093	.717	.909	.207	.7063	59.194	1.000
4.000	.500	-5.39385	5.01034	1.442	-.00652	1.091	.716	.909	.203	.7080	78.865	1.000
6.000	.750	-5.41887	6.13111	1.714	-.00840	1.083	.711	.907	.186	.7158	118.094	1.000
7.000	.875	-5.43616	6.61914	2.118	-.00000	1.082	.710	.907	.182	.7175	137.643	1.000
8.000	1.000	-5.45171	7.07317	1.916	-.01120	1.080	.709	.906	.179	.7190	157.173	1.000
8.000	.097	-5.45171	7.07317	1.916	-.01120	1.080	.709	.906	.179	.7190	157.173	1.000
8.016	.111	-5.46998	7.56619	2.298	-.00000	1.079	.708	.906	.176	.7205	179.848	1.000
8.031	.125	-5.48769	8.02852	2.012	-.00952	1.077	.707	.906	.172	.7223	202.498	1.000
8.063	.154	-5.51673	8.87944	2.082	-.00888	1.071	.702	.904	.158	.7286	247.697	1.000
8.125	.210	-5.57431	10.36690	2.165	-.00892	1.060	.695	.901	.134	.7395	337.635	1.000
8.250	.323	-5.66266	12.81847	2.046	-.00697	1.044	.685	.897	.098	.7557	516.205	1.000
8.500	.549	-5.78870	16.64434	1.662	-.00401	1.026	.673	.893	.059	.7734	870.328	1.000
9.000	1.000	-5.92965	22.38093	1.153	-.00159	1.013	.665	.890	.030	.7864	1573.643	1.000

IDENT= NASA INLET CONFIGURATION NO. 8

STATION COORDINATE, XI1= 14.000 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-3.42462	.00000	.000	.00000	1.132	.742	.918	.294	.6663	.000	1.000
.500	.062	-3.43556	1.79504	.699	-.00096	1.131	.742	.918	.293	.6668	10.123	1.000
1.000	.125	-3.44664	2.53823	1.007	-.00170	1.131	.742	.918	.292	.6675	20.240	1.000
2.000	.250	-3.46916	3.58847	1.481	-.00279	1.129	.741	.918	.288	.6691	40.455	1.000
3.000	.375	-3.49277	4.39318	1.840	-.00680	1.126	.739	.917	.282	.6718	60.633	1.000
4.000	.500	-3.51635	5.07009	2.233	-.00819	1.123	.736	.916	.274	.6758	80.757	1.000
5.000	.625	-3.54231	5.66533	2.710	-.00000	1.121	.735	.916	.270	.6775	100.832	1.000
6.000	.750	-3.56833	6.20289	2.790	-.01187	1.119	.734	.915	.265	.6796	120.875	1.000
7.000	.875	-3.59287	6.69615	2.940	-.01553	1.114	.731	.914	.254	.6848	140.864	1.000
8.000	1.000	-3.61704	7.15381	3.129	-.01186	1.109	.728	.913	.243	.6898	160.777	1.000
8.000	.013	-3.61704	7.15381	3.129	-.01186	1.109	.728	.913	.243	.6898	160.777	1.000
8.016	.015	-3.64508	7.64949	3.245	-.01810	1.103	.724	.912	.230	.6956	183.829	1.000
8.031	.017	-3.67153	8.11299	3.468	-.01842	1.097	.719	.910	.215	.7024	206.782	1.000
8.047	.019	-3.70003	8.54982	3.826	-.00000	1.094	.717	.909	.209	.7054	229.649	1.000
8.063	.021	-3.72672	8.96458	3.549	-.01969	1.090	.715	.909	.202	.7088	252.470	1.000
8.125	.029	-3.81557	10.45057	3.392	-.01541	1.070	.702	.904	.156	.7296	343.107	1.000
8.250	.044	-3.95247	12.89103	2.854	-.00951	1.045	.686	.898	.101	.7543	522.066	1.000
8.500	.075	-4.10842	16.69870	2.042	-.00389	1.025	.672	.893	.055	.7753	876.022	1.000
9.000	.137	-4.27927	22.41631	1.302	-.00155	1.012	.664	.889	.026	.7881	1578.622	1.000
10.000	.260	-4.41355	30.78993	.774	-.00051	1.005	.659	.888	.012	.7948	2978.293	1.000
11.000	.383	-4.49443	37.31975	.565	-.00026	1.003	.658	.887	.007	.7969	4375.497	1.000
12.000	.507	-4.54094	42.86311	.451	-.00016	1.002	.657	.887	.005	.7979	5771.878	1.000
14.000	.753	-4.60610	52.20979	.327	-.00008	1.001	.657	.887	.003	.7989	8563.547	1.000
16.000	1.000	-4.64679	60.11851	.262	-.00005	1.001	.656	.887	.002	.7993	11354.455	1.000

STATION COORDINATE, XI1= 14.500 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-2.47916	.00000	.000	.00000	1.147	.753	.922	.328	.6505	.000	1.000
.500	.062	-2.49043	1.80679	.714	.00038	1.147	.753	.922	.329	.6502	10.256	1.000
1.000	.125	-2.50185	2.55527	1.041	.00046	1.148	.753	.922	.329	.6500	20.513	1.000
2.000	.250	-2.52574	3.61375	1.566	-.00036	1.148	.753	.922	.330	.6499	41.027	1.000
3.000	.375	-2.55143	4.42564	2.062	-.00144	1.147	.753	.922	.329	.6504	61.532	1.000
4.000	.500	-2.57871	5.10954	2.541	-.00327	1.146	.752	.922	.326	.6514	82.019	1.000
5.000	.625	-2.60798	5.71102	2.980	-.01007	1.143	.750	.921	.320	.6542	102.466	1.000
6.000	.750	-2.63780	6.25331	3.408	-.01129	1.139	.748	.920	.311	.6584	122.848	1.000
7.000	.875	-2.66957	6.75024	3.768	-.01573	1.135	.745	.919	.301	.6631	143.149	1.000
8.000	1.000	-2.70059	7.21092	4.127	-.02607	1.128	.740	.918	.286	.6699	163.355	1.000
8.000	.177	-2.70059	7.21092	4.127	-.02607	1.128	.740	.918	.286	.6699	163.355	1.000
8.008	.190	-2.72001	7.46461	4.550	-.00001	1.127	.739	.917	.283	.6715	175.051	1.000
8.016	.203	-2.73930	7.70952	4.416	-.02692	1.124	.738	.917	.277	.6741	186.726	1.000
8.031	.228	-2.77539	8.17553	4.564	-.02417	1.116	.732	.915	.258	.6830	209.982	1.000
8.047	.254	-2.81093	8.61346	4.630	-.03145	1.107	.726	.913	.238	.6922	233.080	1.000
8.063	.280	-2.84455	9.02767	4.674	-.02470	1.098	.720	.910	.218	.7011	256.036	1.000
8.125	.383	-2.96233	10.50739	4.268	-.02035	1.072	.703	.904	.160	.7275	346.848	1.000
8.250	.589	-3.12114	12.93587	3.326	-.01027	1.042	.684	.897	.094	.7575	525.704	1.000
8.500	1.000	-3.30486	16.72861	2.220	-.00385	1.022	.671	.892	.050	.7774	879.163	1.000

IDENT= NASA INLET CONFIGURATION NO. 8

STATION COORDINATE, XI1= 14.750 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-2.00556	.00000	.000	.00000	1.154	.757	.924	.344	.6434	.000	1.000
.500	.062	-2.01653	1.81263	.694	.00114	1.155	.757	.924	.345	.6427	10.322	1.000
1.000	.125	-2.02778	2.56379	1.012	.00164	1.155	.758	.924	.347	.6420	20.650	1.000
2.000	.250	-2.05075	3.62668	1.543	.00208	1.157	.759	.924	.350	.6406	41.321	1.000
3.000	.375	-2.07682	4.44276	2.055	.00196	1.158	.760	.924	.352	.6394	62.009	1.000
4.000	.500	-2.10396	5.13089	2.597	-.00082	1.158	.760	.924	.353	.6390	82.706	1.000
5.000	.625	-2.13528	5.73657	3.184	-.00496	1.157	.759	.924	.351	.6401	103.384	1.000
6.000	.750	-2.16751	6.28278	3.790	-.01698	1.153	.756	.923	.342	.6442	124.009	1.000
6.500	.813	-2.18571	6.53799	4.275	-.00000	1.152	.755	.923	.338	.6459	134.288	1.000
7.000	.875	-2.20413	6.78311	4.374	-.02957	1.149	.754	.922	.333	.6484	144.547	1.000
7.500	.937	-2.22326	7.01909	4.892	-.00001	1.147	.752	.922	.327	.6510	154.779	1.000
8.000	1.000	-2.24288	7.24690	4.883	-.03142	1.145	.751	.921	.324	.6527	164.989	1.000
8.000	.632	-2.24288	7.24690	4.883	-.03142	1.145	.751	.921	.324	.6527	164.989	1.000
8.008	.678	-2.26497	7.50213	5.042	-.03760	1.139	.747	.920	.310	.6591	176.815	1.000
8.016	.724	-2.28691	7.74762	5.260	-.03795	1.132	.743	.918	.295	.6661	188.576	1.000
8.023	.770	-2.30988	7.98450	5.704	-.00002	1.129	.741	.918	.288	.6691	200.284	1.000
8.031	.816	-2.33227	8.21394	5.426	-.04349	1.125	.738	.917	.280	.6731	211.959	1.000
8.047	.908	-2.37376	8.65202	5.466	-.03504	1.112	.730	.914	.251	.6863	235.172	1.000
8.063	1.000	-2.41306	9.06554	5.393	-.03319	1.102	.723	.911	.228	.6969	258.189	1.000

STATION COORDINATE, XI1= 15.000 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-1.54268	.00000	.000	.00000	1.161	.762	.925	.359	.6360	.000	1.000
.500	.062	-1.55306	1.81809	.654	.00184	1.162	.762	.925	.362	.6349	10.384	1.000
1.000	.125	-1.56356	2.57177	.953	.00282	1.163	.763	.926	.364	.6337	20.778	1.000
2.000	.250	-1.58589	3.63889	1.454	.00460	1.166	.765	.926	.370	.6310	41.599	1.000
3.000	.375	-1.61000	4.45916	1.950	.00590	1.169	.767	.927	.376	.6281	62.468	1.000
4.000	.500	-1.63701	5.15190	2.523	.00633	1.171	.768	.928	.382	.6251	83.384	1.000
5.000	.625	-1.66729	5.76290	3.226	.00178	1.173	.770	.928	.386	.6233	104.335	1.000
6.000	.750	-1.70260	6.31497	4.076	-.00445	1.173	.769	.928	.386	.6237	125.283	1.000
6.500	.813	-1.72186	6.57321	4.479	-.01533	1.171	.768	.927	.382	.6254	135.739	1.000
7.000	.875	-1.74236	6.82108	4.962	-.01476	1.169	.767	.927	.377	.6279	146.169	1.000
7.500	.937	-1.76375	7.05947	5.282	-.02947	1.165	.764	.926	.369	.6315	156.565	1.000
8.000	1.000	-1.78571	7.28912	5.649	-.02682	1.161	.762	.925	.359	.6362	166.917	1.000
8.000	.097	-1.78571	7.28912	5.649	-.02682	1.161	.762	.925	.359	.6362	166.917	1.000
8.008	.104	-1.81190	7.54595	5.997	-.03561	1.155	.758	.924	.347	.6418	178.886	1.000
8.016	.111	-1.83857	7.79290	6.290	-.04186	1.149	.754	.922	.333	.6485	190.787	1.000
8.023	.118	-1.86500	8.03074	6.394	-.05383	1.141	.749	.921	.315	.6567	202.610	1.000
8.031	.125	-1.89105	8.26020	6.552	-.04503	1.133	.743	.919	.297	.6648	214.354	1.000
8.047	.139	-1.94127	8.69714	6.497	-.04775	1.119	.734	.915	.265	.6799	237.631	1.000
8.063	.154	-1.98751	9.10902	6.309	-.04156	1.105	.725	.912	.234	.6938	260.671	1.000
8.125	.210	-2.13752	10.57634	5.317	-.02387	1.068	.701	.903	.153	.7310	351.415	1.000
8.250	.323	-2.32671	12.98509	3.749	-.00829	1.038	.681	.896	.085	.7615	529.712	1.000
8.500	.549	-2.52134	16.76017	2.392	-.00381	1.020	.669	.891	.044	.7802	882.484	1.000
9.000	1.000	-2.71107	22.45371	1.425	-.00118	1.009	.662	.889	.021	.7907	1583.893	1.000

IDENT= NASA INLET CONFIGURATION NO. 8

STATION COORDINATE, XI1= 15.250 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
1.000	.125	-1.10906	2.57961	.869	.00358	1.163	.763	.926	.364	.6337	20.896	1.000
2.000	.250	-1.12937	3.64992	1.304	.00685	1.167	.765	.926	.372	.6300	41.852	1.000
3.000	.375	-1.15091	4.47400	1.732	.01069	1.171	.768	.927	.382	.6252	62.884	1.000
4.000	.500	-1.17503	5.17128	2.244	.01474	1.177	.772	.929	.395	.6193	84.013	1.000
5.000	.625	-1.20276	5.78831	2.965	.01786	1.183	.776	.930	.409	.6124	105.258	1.000
6.000	.750	-1.23640	6.34820	4.023	.00841	1.188	.780	.931	.420	.6072	126.605	1.000
6.500	.813	-1.25651	6.61083	4.700	-.00118	1.189	.780	.931	.422	.6065	137.297	1.000
7.000	.875	-1.27853	6.86309	5.405	-.01839	1.187	.779	.931	.418	.6081	147.975	1.000
7.500	.937	-1.30345	7.10539	6.139	-.03520	1.184	.776	.930	.410	.6123	158.608	1.000
8.000	1.000	-1.32924	7.33827	6.787	-.05961	1.177	.772	.929	.394	.6196	169.175	1.000
8.000	.463	-1.32924	7.33827	6.787	-.05961	1.177	.772	.929	.394	.6196	169.175	1.000
8.004	.479	-1.34596	7.46947	7.634	-.00004	1.175	.771	.928	.391	.6212	175.279	1.000
8.008	.496	-1.36305	7.59801	7.394	-.07228	1.172	.769	.928	.384	.6246	181.363	1.000
8.016	.530	-1.39556	7.84708	7.802	-.07632	1.159	.761	.925	.356	.6377	193.449	1.000
8.023	.563	-1.42924	8.08551	8.026	-.07580	1.147	.752	.922	.328	.6505	205.383	1.000
8.031	.597	-1.46145	8.31479	8.062	-.07670	1.135	.744	.919	.301	.6632	217.196	1.000
8.047	.664	-1.52285	8.74957	7.856	-.06466	1.113	.730	.914	.251	.6861	240.504	1.000
8.063	.731	-1.57763	9.15824	7.433	-.05345	1.094	.718	.910	.211	.7046	263.496	1.000
8.125	1.000	-1.74681	10.61448	5.822	-.02101	1.052	.690	.900	.117	.7473	353.954	1.000

STATION COORDINATE, XI1= 15.500 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-.65451	.00000	.000	.00000	1.172	.769	.928	.383	.6249	.000	1.000
.500	.062	-.66311	1.82742	.539	.00267	1.173	.770	.928	.386	.6234	10.491	1.000
1.000	.125	-.67169	2.58528	.770	.00431	1.175	.771	.928	.390	.6216	20.997	1.000
2.000	.250	-.68964	3.65923	1.118	.00794	1.179	.773	.929	.399	.6174	42.066	1.000
3.000	.375	-.70769	4.48627	1.428	.01321	1.184	.777	.930	.411	.6118	63.230	1.000
4.000	.500	-.72741	5.18709	1.772	.02207	1.191	.782	.932	.427	.6039	84.528	1.000
5.000	.625	-.74881	5.80935	2.265	.03586	1.202	.789	.934	.451	.5925	106.024	1.000
6.000	.750	-.77591	6.37825	3.266	.04883	1.216	.798	.938	.483	.5773	127.807	1.000
6.500	.813	-.79305	6.64742	4.128	.04414	1.223	.803	.939	.498	.5695	138.821	1.000
7.000	.875	-.81464	6.90758	5.382	.02009	1.228	.806	.940	.509	.5642	149.900	1.000
7.500	.937	-.84146	7.15848	6.918	-.02328	1.228	.806	.940	.509	.5643	160.987	1.000
8.000	1.000	-.87419	7.39912	8.493	-.07015	1.222	.802	.939	.495	.5711	171.993	1.000
8.000	.177	-.87419	7.39912	8.493	-.07015	1.222	.802	.939	.495	.5711	171.993	1.000
8.004	.183	-.89513	7.53395	9.153	-.11626	1.214	.797	.937	.479	.5792	178.318	1.000
8.008	.190	-.91706	7.66491	9.870	-.11925	1.205	.791	.935	.456	.5890	184.571	1.000
8.016	.203	-.96262	7.91579	10.492	-.13779	1.185	.778	.931	.414	.6103	196.851	1.000
8.023	.216	-1.00686	8.15384	10.586	-.13294	1.164	.764	.926	.367	.6325	208.869	1.000
8.031	.228	-1.04897	8.38098	10.310	-.11099	1.146	.752	.922	.325	.6521	220.668	1.000
8.047	.254	-1.12378	8.81030	9.501	-.07760	1.117	.733	.915	.261	.6816	243.855	1.000
8.063	.280	-1.18829	9.21326	8.666	-.05599	1.097	.720	.910	.216	.7021	266.671	1.000
8.125	.383	-1.37441	10.65386	6.243	-.01827	1.057	.693	.901	.127	.7428	356.586	1.000
8.250	.589	-1.58270	13.03616	4.105	-.00837	1.032	.677	.894	.070	.7683	533.887	1.000
8.500	1.000	-1.80039	16.79120	2.531	-.00289	1.017	.667	.891	.037	.7833	885.755	1.000

IDENT= NASA INLET CONFIGURATION NO. 8

STATION COORDINATE, XI1= 15.625 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
5.000	.625	-.53224	5.81704	1.793	.04016	1.202	.789	.934	.451	.5925	106.305	1.000
6.000	.750	-.55357	6.38951	2.473	.07555	1.220	.801	.938	.492	.5728	128.258	1.000
6.500	.813	-.56683	6.66210	3.169	.10344	1.234	.809	.941	.522	.5581	139.435	1.000
7.000	.875	-.58453	6.92819	4.722	.07964	1.247	.818	.944	.552	.5432	150.796	1.000
7.500	.937	-.61130	7.18682	7.064	.00137	1.253	.822	.946	.565	.5366	162.264	1.000
8.000	1.000	-.64748	7.43520	9.677	-.10984	1.247	.818	.944	.550	.5439	173.674	1.000
8.000	.696	-.64748	7.43520	9.677	-.10984	1.247	.818	.944	.550	.5439	173.674	1.000
8.004	.722	-.67290	7.57329	11.053	-.17756	1.236	.811	.942	.526	.5560	180.185	1.000
8.008	.747	-.69991	7.70630	11.882	-.19849	1.222	.801	.939	.495	.5714	186.570	1.000
8.016	.798	-.75539	7.95798	12.693	-.22508	1.189	.780	.931	.421	.6068	198.955	1.000
8.023	.848	-.80795	8.19403	12.329	-.16670	1.158	.760	.924	.353	.6391	210.933	1.000
8.031	.899	-.85566	8.41846	11.673	-.13057	1.135	.745	.919	.301	.6631	222.646	1.000
8.047	1.000	-.93812	8.84276	10.325	-.07483	1.103	.724	.912	.230	.6956	245.655	1.000

STATION COORDINATE, XI1= 15.750 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-.25392	.00000	.000	.00000	1.178	.772	.929	.396	.6186	.000	1.000
.500	.062	-.26156	1.83098	.478	.00265	1.179	.773	.929	.399	.6172	10.532	1.000
1.000	.125	-.26852	2.59035	.672	.00421	1.181	.774	.930	.403	.6155	21.080	1.000
2.000	.250	-.28654	3.66645	.934	.00795	1.184	.777	.930	.412	.6114	42.232	1.000
3.000	.375	-.29889	4.49533	1.110	.01392	1.190	.781	.932	.424	.6056	63.485	1.000
4.000	.500	-.31562	5.19793	1.239	.02309	1.197	.786	.933	.441	.5975	84.881	1.000
5.000	.625	-.32743	5.82259	1.298	.04422	1.209	.793	.936	.467	.5848	106.508	1.000
6.000	.750	-.34282	6.39681	1.462	.09171	1.230	.807	.941	.514	.5617	128.551	1.000
6.500	.813	-.35012	6.67153	1.776	.12079	1.246	.817	.944	.549	.5448	139.830	1.000
7.000	.875	-.36013	6.94309	2.462	.27082	1.273	.835	.950	.610	.5137	151.445	1.000
7.500	.937	-.37897	7.21476	6.453	.08971	1.298	.851	.955	.664	.4853	163.529	1.000
8.000	1.000	-.42185	7.47743	11.724	-.20123	1.292	.848	.954	.652	.4916	175.652	1.000
8.000	.301	-.42185	7.47743	11.724	-.20123	1.292	.848	.954	.652	.4916	175.652	1.000
8.004	.312	-.45511	7.62156	14.259	-.32421	1.275	.836	.950	.613	.5118	182.489	1.000
8.008	.323	-.49194	7.75686	16.015	-.47372	1.246	.818	.944	.550	.5440	189.026	1.000
8.016	.345	-.56449	8.00584	15.589	-.28810	1.190	.781	.932	.425	.6049	201.356	1.000
8.023	.366	-.62521	8.23713	14.258	-.19147	1.155	.757	.924	.345	.6427	213.158	1.000
8.031	.388	-.67907	8.45710	13.002	-.12600	1.130	.741	.918	.291	.6680	224.695	1.000
8.047	.432	-.76655	8.87516	11.060	-.07218	1.100	.722	.911	.224	.6986	247.458	1.000
8.063	.476	-.83918	9.26979	9.694	-.04552	1.082	.710	.907	.184	.7168	269.954	1.000
8.125	.650	-1.03455	10.69213	6.604	-.01857	1.047	.687	.898	.105	.7527	359.152	1.000
8.250	1.000	-1.25939	13.05978	4.246	-.00674	1.028	.675	.894	.063	.7714	535.823	1.000

STATION COORDINATE, XI1= 15.875 CHANNELS- W2 EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
6.000	.750	-.16725	6.39986	.532	.09316	1.230	.807	.941	.514	.5617	128.674	1.000
6.500	.813	-.16897	6.67480	.182	.18530	1.252	.821	.945	.562	.5381	139.967	1.000
7.000	.875	-.16660	6.94688	-.058	.18404	1.273	.835	.950	.609	.5140	151.610	1.000
7.500	.937	-.17231	7.23048	.649	.87137	1.342	.880	.964	.764	.4304	164.242	1.000
8.000	1.000	-.19908	7.53252	16.910	-.58386	1.374	.902	.971	.836	.3876	178.250	1.000
8.000	.696	-.19908	7.53252	16.910	-.58386	1.374	.902	.971	.836	.3876	178.250	1.000
8.004	.722	-.26266	7.68498	24.346	-1.37830	1.310	.860	.958	.692	.4701	185.539	1.000
8.008	.747	-.31856	7.81607	22.042	-.66862	1.243	.815	.943	.542	.5479	191.923	1.000
8.016	.798	-.40578	8.05431	18.398	-.30167	1.177	.772	.929	.395	.6192	203.801	1.000
8.023	.848	-.47453	8.27767	15.799	-.15335	1.144	.750	.921	.321	.6538	215.261	1.000
8.031	.899	-.53131	8.49264	14.022	-.10813	1.124	.737	.917	.276	.6745	226.587	1.000
8.047	1.000	-.62473	8.90360	11.598	-.05755	1.099	.721	.911	.222	.6996	249.047	1.000

IDENT= NASA INLET CONFIGURATION NO. 8

STATION COORDINATE, XI1= 16.000** CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	-.00730	.00000	.000	.00000	1.178	.773	.929	.398	.6180	.000	1.000
.500	.067	-.01436	1.83297	.441	.00258	1.179	.774	.929	.401	.6166	10.555	1.000
1.000	.133	-.02150	2.59312	.613	.00411	1.181	.775	.930	.404	.6149	21.125	1.000
2.000	.267	-.03441	3.67031	.821	.00765	1.185	.777	.931	.413	.6109	42.321	1.000
3.000	.400	-.04790	4.49977	.920	.01253	1.190	.781	.932	.424	.6056	63.611	1.000
4.000	.533	-.05812	5.20274	.901	.02271	1.197	.785	.933	.440	.5978	85.038	1.000
5.000	.667	-.06860	5.82704	.693	.03743	1.208	.792	.936	.463	.5866	106.671	1.000
6.000	.800	-.07060	6.40033	.014	.09380	1.228	.806	.940	.509	.5646	128.693	1.000
6.500	.867	-.07003	6.67432	-.671	.11613	1.243	.815	.943	.543	.5478	139.947	1.000
7.000	.933	-.06342	6.94551	-1.619	.34187	1.272	.835	.950	.608	.5146	151.551	1.000
7.500	1.000	-.05145	7.22597	-4.648	.64940	1.330	.873	.962	.737	.4457	164.037	1.000

SUM-VM*COS(PHI)*DFLOW = 1393.37
SUM-(P-PSO)*COS(PHI)*DA = 503.91
TOT AXIAL MOMENTUM FLUX = 1897.27

SUM-VM*SIN(PHI)*DFLOW = 7.86
SUM-(P-PSO)*SIN(PHI)*DA = .44
TOTAL Y-MOMENTUM FLUX = 8.30

STATION COORDINATE, XI1= 16.125 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
4.000	.500	.10756	5.20505	.703	.01892	1.197	.785	.933	.439	.5983	85.114	1.000
5.000	.625	.10185	5.82858	.343	.03403	1.206	.791	.935	.460	.5883	106.727	1.000
6.000	.750	.10580	6.39908	-.771	.06149	1.221	.801	.939	.493	.5720	128.643	1.000
6.500	.813	.11011	6.67034	-1.858	.11355	1.234	.809	.941	.522	.5580	139.780	1.000
7.000	.875	.12607	6.93533	-4.129	.11991	1.250	.820	.945	.557	.5404	151.107	1.000
7.500	.937	.15258	7.19838	-9.975	.24813	1.282	.841	.952	.629	.5039	162.787	1.000
8.000	1.000	.22591	7.43870	-23.931	-1.37332	1.229	.806	.940	.510	.5637	173.838	1.000

STATION COORDINATE, XI1= 16.187 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
6.000	.750	.25395	6.39650	-1.181	.03521	1.213	.796	.937	.476	.5803	128.539	1.000
6.500	.813	.26250	6.66441	-2.479	.02873	1.218	.799	.938	.487	.5752	139.532	1.000
7.000	.875	.27792	6.92329	-4.815	.03689	1.225	.803	.939	.502	.5679	150.583	1.000
7.500	.937	.30866	7.17016	-9.673	-.31232	1.210	.794	.936	.468	.5843	161.513	1.000
8.000	1.000	.35670	7.39375	-14.539	-.97360	1.118	.734	.915	.264	.6804	171.743	1.000

STATION COORDINATE, XI1= 16.250 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	.45112	.00000	.000	.00000	1.182	.775	.930	.406	.6141	.000	1.000
.500	.062	.44506	1.83624	.378	.00221	1.183	.776	.930	.408	.6129	10.593	1.000
1.000	.125	.43862	2.59763	.514	.00345	1.184	.777	.930	.411	.6114	21.199	1.000
2.000	.250	.42959	3.67620	.642	.00587	1.187	.779	.931	.418	.6082	42.457	1.000
3.000	.375	.41864	4.50603	.633	.00896	1.191	.781	.932	.427	.6043	63.788	1.000
4.000	.500	.41304	5.20802	.433	.01193	1.195	.784	.933	.436	.5996	85.211	1.000
5.000	.625	.40996	5.82909	-.100	.01615	1.201	.788	.934	.448	.5938	106.746	1.000
6.000	.750	.41665	6.39281	-1.375	.00637	1.205	.791	.935	.458	.5893	128.391	1.000
6.500	.813	.42551	6.65717	-2.532	-.01729	1.204	.790	.935	.456	.5900	139.229	1.000
7.000	.875	.44024	6.90983	-4.423	-.12027	1.195	.784	.933	.436	.5997	149.998	1.000
7.500	.937	.46387	7.14773	-6.725	-.34263	1.162	.762	.925	.362	.6348	160.504	1.000
8.000	1.000	.49252	7.36699	-8.134	-.66769	1.084	.711	.907	.187	.7154	170.502	1.000

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STATION COORDINATE, XI1= 16.375 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
4.000	.500	.73284	5.20995	.275	.00532	1.193	.783	.932	.431	.6020	85.274	1.000
5.000	.625	.73258	5.82801	-.226	-.00243	1.195	.784	.933	.434	.6005	106.707	1.000
6.000	.750	.73810	6.38544	-1.133	-.03253	1.189	.780	.932	.423	.6060	128.095	1.000
6.500	.813	.74483	6.64484	-1.727	-.07053	1.181	.775	.930	.405	.6146	138.714	1.000
7.000	.875	.75299	6.89165	-2.215	-.12549	1.166	.765	.926	.371	.6306	149.209	1.000
7.500	.937	.76284	7.12560	-2.200	-.18311	1.141	.749	.921	.315	.6568	159.512	1.000
8.000	1.000	.76868	7.34789	-.799	-.07231	1.119	.734	.915	.265	.6796	169.619	1.000

STATION COORDINATE, XI1= 16.500 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	1.06524	.00000	.000	.00000	1.186	.778	.931	.415	.6097	.000	1.000
.500	.062	1.06021	1.83993	.314	.00145	1.187	.779	.931	.417	.6088	10.635	1.000
1.000	.125	1.05514	2.60259	.416	.00209	1.188	.779	.931	.419	.6079	21.280	1.000
2.000	.250	1.04716	3.68219	.487	.00288	1.189	.780	.932	.423	.6061	42.595	1.000
3.000	.375	1.03981	4.51158	.430	.00247	1.191	.781	.932	.426	.6046	63.945	1.000
4.000	.500	1.03604	5.21125	.237	-.00094	1.191	.781	.932	.427	.6041	85.317	1.000
5.000	.625	1.03475	5.82707	-.106	-.01149	1.189	.780	.932	.422	.6062	106.672	1.000
6.000	.750	1.03812	6.38105	-.530	-.03765	1.181	.775	.930	.405	.6147	127.919	1.000
6.500	.813	1.04080	6.63877	-.670	-.05404	1.174	.770	.928	.388	.6225	138.460	1.000
7.000	.875	1.04375	6.88487	-.621	-.06581	1.164	.764	.926	.367	.6326	148.916	1.000
7.500	.937	1.04559	7.12041	-.239	-.05902	1.154	.757	.924	.345	.6429	159.279	1.000
8.000	1.000	1.04565	7.34658	.212	-.05502	1.146	.752	.922	.325	.6519	169.559	1.000

STATION COORDINATE, XI1= 16.750 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	1.64654	.00000	.000	.00000	1.189	.780	.932	.423	.6061	.000	1.000
.500	.062	1.64207	1.84291	.278	.00069	1.190	.781	.932	.424	.6057	10.670	1.000
1.000	.125	1.63776	2.60653	.366	.00086	1.190	.781	.932	.424	.6053	21.344	1.000
2.000	.250	1.62997	3.68679	.431	.00044	1.191	.781	.932	.426	.6047	42.702	1.000
3.000	.375	1.62393	4.51576	.411	-.00133	1.190	.781	.932	.425	.6049	64.064	1.000
4.000	.500	1.61916	5.21408	.342	-.00530	1.189	.780	.932	.422	.6063	85.409	1.000
5.000	.625	1.61599	5.82798	.288	-.01213	1.186	.778	.931	.415	.6097	106.705	1.000
6.000	.750	1.61279	6.38085	.382	-.01776	1.181	.775	.930	.404	.6152	127.911	1.000
6.500	.813	1.61082	6.63901	.532	-.01957	1.178	.773	.929	.397	.6184	138.470	1.000
7.000	.875	1.60800	6.88677	.755	-.01929	1.175	.771	.928	.390	.6216	148.998	1.000
7.500	.937	1.60441	7.12522	1.013	-.01915	1.172	.769	.928	.383	.6247	159.495	1.000
8.000	1.000	1.59955	7.35530	1.407	-.02027	1.169	.767	.927	.377	.6277	169.962	1.000

STATION COORDINATE, XI1= 17.000 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	2.21208	.00000	.000	.00000	1.192	.782	.932	.429	.6030	.000	1.000
.500	.062	2.20780	1.84558	.266	.00005	1.192	.782	.932	.429	.6029	10.701	1.000
1.000	.125	2.20361	2.61007	.355	-.00014	1.192	.782	.932	.429	.6029	21.402	1.000
2.000	.250	2.19613	3.69105	.439	-.00092	1.192	.782	.932	.429	.6032	42.801	1.000
3.000	.375	2.18943	4.52009	.474	-.00259	1.191	.781	.932	.427	.6041	64.187	1.000
4.000	.500	2.18357	5.21825	.502	-.00463	1.190	.780	.932	.423	.6057	85.546	1.000
5.000	.625	2.17789	5.83238	.576	-.00577	1.188	.779	.931	.419	.6079	106.866	1.000
6.000	.750	2.17161	6.38667	.741	-.00462	1.186	.778	.931	.415	.6098	128.144	1.000
6.500	.813	2.16799	6.64621	.844	.00002	1.185	.778	.931	.414	.6103	138.771	1.000
7.000	.875	2.16403	6.89595	1.023	.00241	1.186	.778	.931	.414	.6100	149.396	1.000
7.500	.937	2.15906	7.13699	1.317	.00002	1.186	.778	.931	.415	.6099	160.022	1.000
8.000	1.000	2.15333	7.37024	1.499	.01449	1.187	.778	.931	.417	.6090	170.652	1.000

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STATION COORDINATE, XI1= 17.500 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	3.32846	.00000	.000	.00000	1.198	.786	.933	.442	.5970	.000	1.000
.500	.062	3.32381	1.85089	.288	-.00075	1.198	.786	.933	.441	.5974	10.762	1.000
1.000	.125	3.31923	2.61725	.394	-.00109	1.197	.785	.933	.440	.5978	21.520	1.000
2.000	.250	3.31044	3.70040	.535	-.00210	1.196	.785	.933	.438	.5990	43.018	1.000
3.000	.375	3.30201	4.53079	.623	-.00208	1.195	.784	.933	.435	.6001	64.491	1.000
4.000	.500	3.29392	5.23030	.714	-.00202	1.194	.783	.933	.433	.6010	85.942	1.000
5.000	.625	3.28570	5.84621	.812	-.00166	1.193	.783	.932	.432	.6018	107.374	1.000
6.000	.750	3.27745	6.40286	.888	-.00002	1.193	.783	.932	.431	.6021	128.795	1.000
7.000	.875	3.26921	6.91475	.953	-.00020	1.193	.783	.932	.431	.6021	150.212	1.000
8.000	1.000	3.26108	7.39126	1.001	-.00013	1.193	.783	.932	.431	.6022	171.627	1.000

STATION COORDINATE, XI1= 18.000 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	4.44743	.00000	.000	.00000	1.204	.790	.935	.456	.5903	.000	1.000
.500	.062	4.44171	1.85708	.353	-.00129	1.204	.790	.935	.454	.5910	10.835	1.000
1.000	.125	4.43603	2.62579	.491	-.00195	1.203	.789	.935	.453	.5918	21.661	1.000
2.000	.250	4.42503	3.71208	.663	-.00191	1.202	.788	.934	.450	.5930	43.290	1.000
3.000	.375	4.41432	4.54466	.831	-.00446	1.200	.787	.934	.447	.5946	64.886	1.000
4.000	.500	4.40356	5.24558	.874	-.00303	1.198	.786	.934	.443	.5964	86.444	1.000
5.000	.625	4.39440	5.86260	.864	.00000	1.198	.786	.933	.442	.5970	107.977	1.000
6.000	.750	4.38556	6.42037	.940	-.00162	1.198	.786	.933	.441	.5973	129.500	1.000
7.000	.875	4.37707	6.93327	.960	.00000	1.197	.786	.933	.441	.5976	151.017	1.000
8.000	1.000	4.36886	7.41069	1.009	-.00013	1.197	.786	.933	.441	.5975	172.531	1.000

STATION COORDINATE, XI1= 19.000 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	6.72688	.00000	.000	.00000	1.222	.801	.939	.495	.5713	.000	1.000
.500	.062	6.71702	1.87552	.602	-.00253	1.220	.801	.938	.492	.5729	11.051	1.000
1.000	.125	6.70762	2.65128	.819	-.00308	1.219	.800	.938	.489	.5742	22.083	1.000
2.000	.250	6.68778	3.74629	1.148	-.00557	1.216	.798	.937	.482	.5774	44.091	1.000
3.000	.375	6.67150	4.58497	1.119	.00000	1.215	.797	.937	.479	.5789	66.042	1.000
4.000	.500	6.65545	5.29124	1.541	-.00730	1.213	.796	.937	.476	.5805	87.956	1.000
6.000	.750	6.61863	6.47097	1.911	-.01356	1.206	.791	.935	.459	.5886	131.549	1.000
8.000	1.000	6.58423	7.45832	2.080	-.01403	1.197	.786	.933	.441	.5975	174.756	1.000

STATION COORDINATE, XI1= 20.000 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	9.03156	.00000	.000	.00000	1.244	.816	.944	.545	.5465	.000	1.000
.500	.062	9.01878	1.90418	.769	.00000	1.245	.817	.944	.548	.5452	11.391	1.000
1.000	.125	9.00450	2.69301	1.282	-.00395	1.245	.816	.944	.546	.5461	22.784	1.000
2.000	.250	8.97541	3.80625	1.843	-.00503	1.242	.815	.943	.540	.5489	45.514	1.000
4.000	.500	8.90957	5.37236	2.630	-.00955	1.235	.810	.942	.525	.5563	90.673	1.000
6.000	.750	8.85547	6.56829	2.781	.00000	1.232	.808	.941	.518	.5599	135.536	1.000
8.000	1.000	8.79703	7.57358	3.873	-.01317	1.229	.807	.940	.512	.5629	180.199	1.000

STATION COORDINATE, XI1= 21.000 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	11.34032	.00000	.000	.00000	1.276	.837	.950	.615	.5111	.000	1.000
1.000	.125	11.30055	2.75285	1.655	-.00172	1.275	.836	.950	.613	.5122	23.807	1.000
2.000	.250	11.26071	3.89109	2.362	-.00289	1.273	.835	.950	.610	.5136	47.565	1.000
4.000	.500	11.17895	5.49643	3.507	-.00391	1.271	.834	.949	.605	.5164	94.910	1.000
8.000	1.000	11.00568	7.75210	5.279	-.00864	1.264	.829	.948	.590	.5238	188.794	1.000

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STATION COORDINATE, XI1= 22.000 CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	13.58335	.00000	.000	.00000	1.304	.855	.956	.678	.4779	.000	1.000
1.000	.125	13.53934	2.82071	1.788	-.00034	1.303	.855	.956	.677	.4783	24.996	1.000
2.000	.250	13.49485	3.98823	2.559	-.00018	1.303	.855	.956	.677	.4785	49.970	1.000
4.000	.500	13.40585	5.63873	3.705	.00081	1.304	.855	.956	.678	.4781	99.888	1.000
8.000	1.000	13.21079	7.97045	5.859	-.00049	1.304	.855	.956	.679	.4776	199.579	1.000

STATION COORDINATE, XI1= 24.000** CHANNELS- W2 SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
.000	.000	17.97832	.00000	.000	.00000	1.349	.885	.966	.779	.4216	.000	1.000
1.000	.125	17.93102	2.95999	1.831	-.00000	1.349	.885	.966	.779	.4216	27.525	1.000
2.000	.250	17.88434	4.18559	2.582	-.00000	1.349	.885	.966	.779	.4216	55.038	1.000
4.000	.500	17.78814	5.91726	3.603	.00000	1.349	.885	.966	.778	.4220	110.000	1.000
8.000	1.000	17.62415	8.37429	4.034	.01127	1.352	.887	.966	.786	.4172	220.316	1.000

SUM-VM*COS(PHI)*DFLOW = 1083.32 SUM-VM*SIN(PHI)*DFLOW = 60.30
SUM-(P-PSO)*COS(PHI)*DA = 1131.12 SUM-(P-PSO)*SIN(PHI)*DA = 63.06
TOT AXIAL MOMENTUM FLUX = 2214.44 TOTAL Y-MOMENTUM FLUX = 123.35

STATION COORDINATE, XI1= 16.000** CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.004	.000	-.15692	7.74241	32.016	-.83021	1.261	.827	.947	.582	.5281	188.322	1.000
8.008	.001	-.21786	7.86115	26.150	-.62637	1.208	.793	.936	.465	.5857	194.143	1.000
8.016	.002	-.31853	8.08457	19.783	-.22173	1.146	.752	.922	.327	.6513	205.335	1.000
8.023	.003	-.38622	8.30331	16.564	-.13670	1.120	.735	.916	.268	.6786	216.597	1.000
8.031	.004	-.44618	8.51430	14.508	-.08508	1.102	.723	.912	.228	.6966	227.745	1.000
8.047	.006	-.53873	8.92146	11.865	-.04864	1.082	.710	.907	.183	.7174	250.047	1.000
8.063	.008	-.61470	9.30924	10.217	-.03446	1.069	.701	.904	.154	.7305	272.257	1.000
8.125	.016	-.81777	10.71762	6.796	-.01215	1.043	.684	.897	.096	.7565	360.866	1.000
8.250	.031	-1.04262	13.07602	4.323	-.00565	1.026	.673	.893	.058	.7736	537.157	1.000
8.500	.062	-1.25913	16.81552	2.610	-.00221	1.014	.665	.890	.031	.7858	888.322	1.000
9.000	.125	-1.45954	22.48568	1.498	-.00088	1.007	.660	.888	.015	.7931	1588.407	1.000
10.000	.250	-1.61407	30.82947	.839	-.00030	1.003	.658	.887	.007	.7969	2985.946	1.000
11.000	.375	-1.69899	37.34820	.598	-.00015	1.002	.657	.887	.004	.7981	4382.169	1.000
12.000	.500	-1.74834	42.88562	.471	-.00009	1.001	.657	.887	.003	.7988	5777.943	1.000
14.000	.750	-1.81554	52.22600	.338	-.00005	1.001	.656	.887	.001	.7993	8568.865	1.000
16.000	1.000	-1.85738	60.13146	.269	-.00003	1.000	.656	.887	.001	.7996	11359.345	1.000

SUM-VM*COS(PHI)*DFLOW = 146053.71 SUM-VM*SIN(PHI)*DFLOW = 2392.03
SUM-(P-PSO)*COS(PHI)*DA = 739.21 SUM-(P-PSO)*SIN(PHI)*DA = 80.34
TOT AXIAL MOMENTUM FLUX = 146792.91 TOTAL Y-MOMENTUM FLUX = 2472.37

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STATION COORDINATE, XI1= 16.094 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	.01011	7.71620	58.934	11.41643	.684	.449	.795	-.705	1.1341	187.050	1.000
8.004	.008	-.07607	7.79674	35.370	-.36475	1.184	.777	.930	.411	.6117	190.975	1.000
8.008	.016	-.13775	7.90282	28.511	-.28588	1.150	.754	.923	.334	.6479	196.207	1.000
8.016	.031	-.24017	8.11346	20.623	-.12935	1.117	.733	.915	.261	.6818	206.805	1.000
8.023	.047	-.30768	8.32708	17.079	-.08226	1.100	.722	.911	.223	.6988	217.839	1.000
8.031	.062	-.36912	8.53449	14.835	-.05834	1.089	.714	.908	.198	.7104	228.826	1.000
8.047	.094	-.46069	8.93801	12.064	-.03859	1.073	.704	.905	.164	.7260	250.975	1.000
8.063	.125	-.53813	9.32314	10.355	-.02776	1.063	.697	.902	.141	.7365	273.070	1.000
8.125	.250	-.73973	10.72696	6.848	-.01100	1.041	.683	.897	.092	.7583	361.495	1.000
8.250	.500	-.96613	13.08182	4.348	-.00579	1.025	.673	.893	.056	.7747	537.633	1.000
8.500	1.000	-1.19357	16.81851	2.618	-.00212	1.014	.665	.890	.031	.7861	888.638	1.000

STATION COORDINATE, XI1= 16.187 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	.09343	7.78277	27.107	2.07674	.538	.353	.742	-1.032	1.3169	190.291	1.000
8.004	.008	.04262	7.87653	29.521	1.72438	.793	.520	.830	-.462	1.0129	194.904	1.000
8.008	.016	-.00958	7.97084	25.665	.88533	.940	.617	.871	-.133	.8601	199.599	1.000
8.016	.031	-.08833	8.17090	20.316	.18171	1.035	.679	.895	.077	.7652	209.744	1.000
8.023	.047	-.15954	8.37307	17.208	.04978	1.050	.689	.899	.112	.7493	220.251	1.000
8.031	.062	-.21672	8.57532	15.059	.00799	1.055	.692	.900	.123	.7447	231.021	1.000
8.047	.094	-.31365	8.96977	12.275	-.01048	1.054	.691	.900	.120	.7458	252.762	1.000
8.063	.125	-.38935	9.35060	10.536	-.01391	1.050	.689	.899	.111	.7498	274.681	1.000
8.125	.250	-.60050	10.74378	6.928	-.00884	1.037	.680	.896	.082	.7631	362.630	1.000
8.250	.500	-.82099	13.09291	4.392	-.00487	1.023	.671	.892	.052	.7768	538.546	1.000
8.500	1.000	-1.05005	16.82510	2.635	-.00194	1.013	.665	.890	.029	.7868	889.334	1.000

STATION COORDINATE, XI1= 16.375 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	.29541	7.85990	17.202	.39732	.662	.434	.788	-.754	1.1597	194.082	1.000
8.004	.008	.26787	7.96292	12.864	1.15033	.779	.511	.825	-.494	1.0283	199.202	1.000
8.008	.016	.24262	8.06421	16.499	.29148	.859	.564	.849	-.314	.9432	204.302	1.000
8.016	.031	.17972	8.26068	16.397	.30119	.919	.603	.866	-.180	.8815	214.379	1.000
8.023	.047	.12638	8.45732	15.265	.17764	.967	.635	.878	-.073	.8328	224.706	1.000
8.031	.062	.07452	8.65180	14.091	.10421	.993	.652	.885	-.015	.8069	235.160	1.000
8.047	.094	-.01270	9.03502	12.056	.03529	1.016	.666	.891	.036	.7839	256.453	1.000
8.063	.125	-.08717	9.40702	10.535	.01402	1.024	.672	.893	.053	.7760	278.006	1.000
8.125	.250	-.29392	10.78140	7.053	-.00533	1.027	.674	.893	.061	.7723	365.174	1.000
8.250	.500	-.52044	13.11619	4.462	-.00314	1.019	.668	.891	.042	.7812	540.462	1.000
8.500	1.000	-.75227	16.83888	2.665	-.00156	1.012	.664	.889	.026	.7883	890.792	1.000

STATION COORDINATE, XI1= 16.563 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	.50391	7.91790	14.371	.14198	.855	.561	.848	-.324	.9479	196.956	1.000
8.004	.008	.47802	8.01981	14.158	.17581	.874	.573	.853	-.282	.9285	202.059	1.000
8.008	.016	.45276	8.12075	13.978	.11585	.889	.583	.857	-.247	.9124	207.177	1.000
8.016	.031	.40385	8.31984	13.592	.11654	.913	.599	.864	-.194	.8880	217.460	1.000
8.023	.047	.35728	8.51561	13.201	.12279	.937	.615	.870	-.140	.8635	227.814	1.000
8.031	.062	.31294	8.70843	12.641	.10123	.959	.629	.876	-.093	.8418	238.248	1.000
8.047	.094	.23271	9.08604	11.381	.05857	.987	.647	.883	-.029	.8132	259.358	1.000
8.063	.125	.16284	9.45286	10.203	.03157	1.002	.657	.887	.004	.7981	280.722	1.000
8.125	.250	-.04059	10.81286	7.093	-.00009	1.019	.668	.891	.042	.7812	367.309	1.000
8.250	.500	-.26696	13.13606	4.497	-.00165	1.016	.667	.891	.036	.7838	542.101	1.000
8.500	1.000	-.50006	16.85067	2.685	-.00124	1.010	.663	.889	.023	.7895	892.039	1.000

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STATION COORDINATE, XI1= 16.750 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	.71431	7.96863	12.796	.10979	.873	.573	.853	-.283	.9287	199.488	1.000
8.004	.008	.69092	8.07058	13.049	.00054	.877	.576	.854	-.274	.9246	204.625	1.000
8.008	.016	.66795	8.17139	12.507	.11667	.884	.580	.856	-.259	.9176	209.769	1.000
8.016	.031	.62500	8.37035	12.168	.10279	.908	.596	.862	-.206	.8933	220.109	1.000
8.023	.047	.58320	8.56555	11.810	.08699	.927	.608	.867	-.163	.8740	230.494	1.000
8.031	.062	.54394	8.75754	11.412	.08045	.943	.619	.872	-.127	.8576	240.943	1.000
8.047	.094	.47078	9.13221	10.569	.05826	.968	.635	.878	-.071	.8321	262.000	1.000
8.063	.125	.40603	9.49556	9.696	.03998	.985	.646	.883	-.034	.8152	283.264	1.000
8.125	.250	.20839	10.84380	7.059	.00480	1.010	.662	.889	.022	.7901	369.413	1.000
8.250	.500	-.01590	13.15584	4.510	-.00021	1.013	.665	.890	.030	.7865	543.735	1.000
8.500	1.000	-.24944	16.86245	2.700	-.00091	1.009	.662	.889	.020	.7908	893.288	1.000

STATION COORDINATE, XI1= 17.125 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	1.13842	8.05510	10.527	.06264	.884	.580	.856	-.259	.9176	203.841	1.000
8.008	.031	1.10109	8.25788	10.339	.05446	.896	.588	.859	-.231	.9049	214.233	1.000
8.016	.062	1.06521	8.45631	10.132	.05556	.908	.595	.862	-.206	.8935	224.653	1.000
8.023	.094	1.03101	8.65080	9.849	.06318	.920	.603	.866	-.179	.8813	235.105	1.000
8.031	.125	.99814	8.84159	9.693	.04940	.930	.610	.868	-.155	.8704	245.590	1.000
8.047	.187	.93639	9.21299	9.178	.04444	.948	.622	.873	-.117	.8529	266.656	1.000
8.063	.250	.88002	9.57202	8.648	.03623	.962	.631	.877	-.086	.8388	287.844	1.000
8.125	.500	.70169	10.90385	6.771	.01542	.993	.651	.885	-.016	.8073	373.516	1.000
8.250	1.000	.47586	13.19458	4.490	.00166	1.006	.660	.888	.013	.7944	546.941	1.000

STATION COORDINATE, XI1= 17.500 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	1.56489	8.12921	9.305	.03850	.898	.589	.860	-.229	.9038	207.609	1.000
8.008	.008	1.53228	8.33138	9.024	.05051	.907	.595	.862	-.207	.8938	218.064	1.000
8.016	.016	1.50125	8.52926	8.934	.03905	.917	.601	.865	-.186	.8842	228.545	1.000
8.023	.023	1.47042	8.72284	9.041	.00009	.920	.604	.866	-.178	.8806	239.037	1.000
8.031	.031	1.44107	8.91252	8.540	.04032	.924	.606	.867	-.169	.8764	249.546	1.000
8.047	.047	1.38735	9.28153	8.151	.03415	.938	.616	.871	-.137	.8621	270.638	1.000
8.063	.062	1.33738	9.63784	7.751	.03148	.950	.623	.874	-.112	.8505	291.816	1.000
8.125	.125	1.17565	10.95832	6.337	.01632	.979	.642	.881	-.046	.8208	377.258	1.000
8.250	.250	.96226	13.23250	4.417	.00350	.998	.655	.886	-.003	.8016	550.090	1.000
8.500	.500	.74430	16.90957	2.716	.00036	1.004	.659	.888	.009	.7961	898.287	1.000
9.000	1.000	.53423	22.53910	1.558	-.00016	1.002	.657	.887	.005	.7978	1595.964	1.000

STATION COORDINATE, XI1= 18.250 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	2.42138	8.25522	7.436	.03372	.908	.596	.862	-.206	.8933	214.095	1.000
8.008	.008	2.39467	8.45539	7.762	.00003	.910	.597	.863	-.201	.8910	224.604	1.000
8.016	.016	2.36892	8.65112	7.095	.03418	.914	.599	.864	-.192	.8872	235.122	1.000
8.031	.031	2.32353	9.03099	6.888	.02442	.925	.607	.867	-.167	.8757	256.225	1.000
8.047	.047	2.27970	9.39637	6.579	.02683	.934	.613	.869	-.147	.8663	277.377	1.000
8.063	.062	2.23990	9.74909	6.400	.02037	.942	.618	.872	-.128	.8581	298.592	1.000
8.125	.125	2.10245	11.05430	5.499	.01508	.965	.633	.877	-.079	.8356	383.895	1.000
8.250	.250	1.91496	13.30406	4.148	.00634	.986	.647	.883	-.030	.8137	556.056	1.000
8.500	.500	1.70339	16.95472	2.663	.00157	.999	.655	.886	-.003	.8015	903.090	1.000
9.000	1.000	1.49667	22.56529	1.557	.00019	1.000	.656	.887	-.000	.8000	1599.675	1.000

IDENT= NASA INLET CONFIGURATION NO. 8

STATION COORDINATE, XI1= 19.000 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	3.28117	8.35638	6.162	.01435	.929	.609	.868	-.159	.8722	219.374	1.000
8.016	.002	3.23835	8.75054	6.237	.00002	.930	.610	.868	-.156	.8704	240.558	1.000
8.031	.004	3.19839	9.12804	5.829	.01759	.934	.612	.869	-.148	.8671	261.761	1.000
8.047	.006	3.16124	9.49095	5.897	.00002	.937	.615	.870	-.141	.8638	282.989	1.000
8.063	.008	3.12627	9.84086	5.452	.01674	.940	.617	.871	-.134	.8607	304.240	1.000
8.125	.016	3.01308	11.13605	4.787	.01210	.958	.628	.876	-.094	.8425	389.594	1.000
8.250	.031	2.84159	13.36842	3.792	.00706	.978	.641	.881	-.050	.8224	561.449	1.000
8.500	.062	2.65015	16.99799	2.566	.00202	.992	.651	.884	-.018	.8081	907.705	1.000
9.000	.125	2.44580	22.59096	1.538	.00053	.998	.655	.886	-.005	.8022	1603.316	1.000
10.000	.250	2.29430	30.88792	.860	.00011	.999	.656	.886	-.001	.8005	2997.279	1.000
11.000	.375	2.20553	37.38965	.611	.00003	1.000	.656	.886	-.000	.8002	4391.903	1.000
12.000	.500	2.15589	42.91818	.480	.00001	1.000	.656	.886	-.000	.8001	5786.721	1.000
14.000	.750	2.08702	52.24923	.343	.00000	1.000	.656	.887	-.000	.8000	8576.491	1.000
16.000	1.000	2.04459	60.14993	.273	-.00000	1.000	.656	.887	-.000	.8000	11366.326	1.000

STATION COORDINATE, XI1= 20.500 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	5.00467	8.52207	4.909	.00998	.935	.613	.870	-.146	.8662	228.160	1.000
8.031	.031	4.94229	9.28306	4.463	.00963	.942	.618	.872	-.130	.8586	270.727	1.000
8.063	.062	4.88889	9.98775	4.235	.00729	.948	.622	.873	-.117	.8528	313.390	1.000
8.125	.125	4.79880	11.26869	3.790	.00732	.957	.628	.875	-.097	.8436	398.930	1.000
8.250	.250	4.66581	13.47832	3.129	.00560	.970	.637	.879	-.066	.8300	570.717	1.000
8.500	.500	4.49764	17.07671	2.296	.00308	.984	.646	.883	-.035	.8156	916.133	1.000
9.000	1.000	4.31531	22.63997	1.459	.00094	.994	.652	.885	-.014	.8062	1610.281	1.000

STATION COORDINATE, XI1= 22.000 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	6.73089	8.65664	4.043	.00778	.944	.620	.872	-.124	.8561	235.423	1.000
8.031	.004	6.67813	9.40880	3.983	.00000	.946	.621	.873	-.120	.8542	278.111	1.000
8.063	.008	6.63210	10.10574	3.512	.00714	.949	.622	.873	-.114	.8517	320.838	1.000
8.125	.016	6.56028	11.37471	3.122	.00589	.957	.628	.875	-.096	.8436	406.472	1.000
8.250	.031	6.44836	13.56736	2.608	.00458	.968	.635	.878	-.072	.8327	578.283	1.000
8.500	.062	6.31014	17.14438	1.983	.00293	.980	.643	.881	-.045	.8202	923.407	1.000
9.000	.125	6.14605	22.68479	1.339	.00135	.990	.650	.884	-.021	.8096	1616.663	1.000
10.000	.250	6.00494	30.94220	.806	.00041	.996	.654	.886	-.008	.8037	3007.823	1.000
11.000	.375	5.92344	37.42871	.586	.00020	.998	.655	.886	-.005	.8021	4401.084	1.000
12.000	.500	5.87448	42.94903	.467	.00011	.999	.655	.886	-.003	.8013	5795.042	1.000
14.000	.750	5.80854	52.27138	.338	.00005	.999	.656	.886	-.002	.8007	8583.764	1.000
16.000	1.000	5.76669	60.16758	.270	.00003	1.000	.656	.886	-.001	.8005	11372.997	1.000

STATION COORDINATE, XI1= 25.000 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	10.18795	8.85741	2.682	.00618	.946	.621	.873	-.120	.8544	246.469	1.000
8.063	.008	10.12574	10.28132	2.322	.00474	.953	.626	.875	-.104	.8469	332.084	1.000
8.125	.016	10.07777	11.53319	2.089	.00436	.959	.629	.876	-.092	.8414	417.878	1.000
8.250	.031	10.00462	13.70243	1.776	.00359	.967	.634	.878	-.074	.8332	589.855	1.000
8.500	.062	9.90696	17.25076	1.418	.00255	.977	.641	.881	-.051	.8230	934.903	1.000
9.000	.125	9.78871	22.76077	1.048	.00144	.987	.648	.883	-.029	.8130	1627.511	1.000
10.000	.250	9.66666	30.99059	.703	.00058	.994	.652	.885	-.013	.8059	3017.239	1.000
11.000	.375	9.59673	37.46474	.534	.00029	.997	.654	.886	-.008	.8035	4409.562	1.000
12.000	.500	9.55054	42.97808	.436	.00018	.998	.655	.886	-.005	.8023	5802.884	1.000
14.000	.750	9.48929	52.29268	.324	.00008	.999	.655	.886	-.003	.8013	8590.761	1.000
16.000	1.000	9.44893	60.18468	.262	.00005	.999	.655	.886	-.002	.8008	11379.462	1.000

IDENT= NASA INLET CONFIGURATION NO. 8

STATION COORDINATE, XI1= 28.000 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	13.64853	8.98400	1.511	.00587	.949	.623	.873	-.113	.8513	253.565	1.000
8.063	.008	13.61380	10.39265	1.314	.00534	.957	.628	.875	-.096	.8436	339.314	1.000
8.125	.016	13.58659	11.63436	1.215	.00433	.962	.631	.877	-.084	.8378	425.241	1.000
8.250	.031	13.54304	13.79050	1.090	.00318	.970	.636	.879	-.067	.8302	597.462	1.000
8.500	.062	13.48121	17.32389	.942	.00210	.979	.642	.881	-.048	.8216	942.846	1.000
9.000	.125	13.39849	22.81786	.772	.00123	.987	.647	.883	-.029	.8132	1635.685	1.000
10.000	.250	13.30377	31.03138	.582	.00058	.993	.652	.885	-.015	.8068	3025.185	1.000
11.000	.375	13.24397	37.49674	.470	.00032	.996	.653	.885	-.009	.8042	4417.097	1.000
12.000	.500	13.20273	43.00466	.397	.00020	.997	.654	.886	-.006	.8029	5810.063	1.000
14.000	.750	13.14591	52.31280	.306	.00010	.998	.655	.886	-.004	.8017	8597.374	1.000
16.000	1.000	13.10761	60.20104	.251	.00006	.999	.655	.886	-.003	.8012	11385.652	1.000

STATION COORDINATE, XI1= 34.000 CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	20.57396	9.05011	.121	-.00000	.984	.646	.883	-.035	.8158	257.311	1.000
8.063	.008	20.57009	10.46381	.194	.00028	.985	.646	.883	-.035	.8156	343.977	1.000
8.125	.016	20.56522	11.70817	.252	.00049	.985	.646	.883	-.034	.8151	430.653	1.000
8.250	.031	20.55432	13.86640	.320	.00065	.986	.647	.883	-.031	.8140	604.056	1.000
8.500	.062	20.53258	17.39930	.380	.00068	.988	.648	.884	-.026	.8118	951.072	1.000
9.000	.125	20.49421	22.88819	.411	.00054	.991	.650	.884	-.019	.8087	1645.784	1.000
10.000	.250	20.43600	31.09123	.397	.00032	.995	.652	.885	-.012	.8055	3036.866	1.000
11.000	.375	20.39303	37.54817	.362	.00020	.996	.653	.886	-.009	.8039	4429.223	1.000
12.000	.500	20.35992	43.04965	.328	.00014	.997	.654	.886	-.007	.8031	5822.228	1.000
14.000	.750	20.31146	52.34871	.270	.00008	.998	.655	.886	-.005	.8022	8609.180	1.000
16.000	1.000	20.27753	60.23077	.223	.00007	.998	.655	.886	-.004	.8017	11396.900	1.000

STATION COORDINATE, XI1= 40.000** CHANNELS- EXT SUB

XI2	STRM FNCT	X,Z	Y,R	PHI	CURV	PS/PO	PS/PT	TS/TT	CP	MACH	AREA	PT/PTO
8.000	.000	27.49987	9.06430	.114	.00000	.998	.654	.886	-.005	.8025	258.118	1.000
8.063	.008	27.49676	10.48266	.137	.00000	.998	.654	.886	-.005	.8025	345.218	1.000
8.125	.016	27.49359	11.73076	.154	.00000	.998	.654	.886	-.005	.8025	432.317	1.000
8.250	.031	27.48709	13.89460	.190	-.00000	.998	.654	.886	-.005	.8025	606.516	1.000
8.500	.062	27.47368	17.43439	.245	.00000	.998	.654	.886	-.005	.8025	954.912	1.000
9.000	.125	27.44696	22.92930	.303	-.00000	.998	.654	.886	-.005	.8025	1651.701	1.000
10.000	.250	27.40119	31.13424	.332	.00000	.998	.654	.886	-.005	.8025	3045.274	1.000
11.000	.375	27.36395	37.58894	.321	.00000	.998	.654	.886	-.005	.8025	4438.846	1.000
12.000	.500	27.33419	43.08732	.300	.00000	.998	.654	.886	-.005	.8025	5832.421	1.000
14.000	.750	27.28886	52.38031	.254	.00000	.998	.654	.886	-.005	.8025	8619.578	1.000
16.000	1.000	27.25704	60.25678	.209	.00000	.998	.654	.886	-.005	.8025	11406.745	1.000

SUM-VM*COS(PHI)*DFLOW = 147344.32 SUM-VM*SIN(PHI)*DFLOW = 710.57
SUM-(P-PSO)*COS(PHI)*DA = -399.93 SUM-(P-PSO)*SIN(PHI)*DA = -1.93
TOT AXIAL MOMENTUM FLUX = 146944.40 TOTAL Y-MOMENTUM FLUX = 708.64

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=W2 STREAMLINE COORDINATE, XI2= .000.

XII	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.31991	.00000	.000	.00000	1.002	.005	.657	.7978	-.0000	1.000	1.000
4.000	7.347	-21.97252	.00000	.000	.00000	1.010	.023	.663	.7898	-.0000	1.000	1.000
8.000	14.704	-14.61555	.00000	.000	.00000	1.025	.055	.672	.7753	-.0000	1.000	1.000
10.000	18.398	-10.92239	.00000	.000	.00000	1.042	.094	.684	.7578	-.0000	1.000	1.000
12.000	22.113	-7.20641	.00000	.000	.00000	1.073	.162	.704	.7266	-.0000	1.000	1.000
13.000	23.995	-5.32510	.00000	.000	.00000	1.100	.224	.722	.6984	-.0000	1.000	1.000
14.000	25.895	-3.42462	.00000	.000	.00000	1.132	.294	.742	.6663	-.0000	1.000	1.000
14.500	26.841	-2.47916	.00000	.000	.00000	1.147	.328	.753	.6505	-.0000	1.000	1.000
14.750	27.314	-2.00556	.00000	.000	.00000	1.154	.344	.757	.6434	-.0000	1.000	1.000
15.000	27.777	-1.54268	.00000	.000	.00000	1.161	.359	.762	.6360	-.0000	1.000	1.000
15.500	28.665	-.65451	.00000	.000	.00000	1.172	.383	.769	.6249	-.0000	1.000	1.000
15.750	29.066	-.25392	.00000	.000	.00000	1.178	.396	.772	.6186	-.0000	1.000	1.000
16.000	29.313	-.00730	.00000	.000	.00000	1.178	.398	.773	.6180	-.0000	1.000	1.000
16.250	29.771	.45112	.00000	.000	.00000	1.182	.406	.775	.6141	-.0000	1.000	1.000
16.500	30.385	1.06524	.00000	.000	.00000	1.186	.415	.778	.6097	-.0000	1.000	1.000
16.750	30.966	1.64654	.00000	.000	.00000	1.189	.423	.780	.6061	-.0000	1.000	1.000
17.000	31.532	2.21208	.00000	.000	.00000	1.192	.429	.782	.6030	-.0000	1.000	1.000
17.500	32.648	3.32846	.00000	.000	.00000	1.198	.442	.786	.5970	-.0000	1.000	1.000
18.000	33.767	4.44743	.00000	.000	.00000	1.204	.456	.790	.5903	-.0000	1.000	1.000
19.000	36.047	6.72688	.00000	.000	.00000	1.222	.495	.801	.5713	-.0000	1.000	1.000
20.000	38.351	9.03156	.00000	.000	.00000	1.244	.545	.816	.5465	-.0000	1.000	1.000
21.000	40.660	11.34032	.00000	.000	.00000	1.276	.615	.837	.5111	-.0000	1.000	1.000
22.000	42.903	13.58335	.00000	.000	.00000	1.304	.678	.855	.4779	-.0000	1.000	1.000
24.000	47.298	17.97832	.00000	.000	.00000	1.349	.779	.885	.4216	-.0000	1.000	1.000

TT/TTO = 1.000

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=W2 STREAMLINE COORDINATE, XI2= 8.000,

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.32478	6.91388	.079	.00000	1.002	.005	.657	.7978	-.0000	.410	1.000
4.000	7.346	-21.97887	6.92512	.105	-.00013	1.010	.022	.662	.7901	-.0000	.408	1.000
8.000	14.692	-14.63298	6.94664	.267	-.00064	1.023	.051	.671	.7768	-.0002	.404	1.000
10.000	18.365	-10.96012	6.97179	.575	-.00228	1.037	.083	.680	.7626	-.0005	.400	1.000
12.000	22.038	-7.28758	7.02619	1.156	-.00324	1.062	.138	.697	.7377	-.0015	.391	1.000
13.000	23.874	-5.45171	7.07317	1.916	-.01120	1.080	.179	.709	.7190	-.0028	.382	1.000
14.000	25.711	-3.61704	7.15381	3.129	-.01186	1.109	.243	.728	.6898	-.0058	.368	1.000
14.500	26.629	-2.70059	7.21092	4.127	-.02607	1.128	.286	.740	.6699	-.0085	.358	1.000
14.750	27.088	-2.24288	7.24690	4.883	-.03142	1.145	.324	.751	.6527	-.0104	.352	1.000
15.000	27.547	-1.78571	7.28912	5.649	-.02682	1.161	.359	.762	.6362	-.0130	.344	1.000
15.250	28.006	-1.32924	7.33827	6.787	-.05961	1.177	.394	.772	.6196	-.0163	.335	1.000
15.500	28.465	-.87419	7.39912	8.493	-.07015	1.222	.495	.802	.5711	-.0213	.324	1.000
15.625	28.695	-.64748	7.43520	9.677	-.10984	1.247	.550	.818	.5439	-.0247	.318	1.000
15.750	28.925	-.42185	7.47743	11.724	-.20123	1.292	.652	.848	.4916	-.0294	.310	1.000
15.875	29.154	-.19908	7.53252	16.910	-.58386	1.374	.836	.902	.3876	-.0370	.300	1.000
16.000	29.384	.01540	7.61385	-14.906	2.85262	1.524	1.170	1.000	.0000	-.0522	.284	1.000

TT/TTO = 1.000

ADDITIVE DRAG = -.0522

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=W2   STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
16.000	.000	.01540	7.61385	-14.906	2.85262	1.524	1.170	1.000	.0000	-.0522	.284	1.000
16.125	.277	.22591	7.43870	-23.931	-1.37332	1.229	.510	.806	.5637	-.0249	.317	1.000
16.187	.415	.35670	7.39375	-14.539	-.97360	1.118	.264	.734	.6804	-.0217	.325	1.000
16.250	.554	.49252	7.36699	-8.134	-.66769	1.084	.187	.711	.7154	-.0206	.330	1.000
16.375	.831	.76868	7.34789	-.799	-.07231	1.119	.265	.734	.6796	-.0198	.333	1.000
16.500	1.108	1.04565	7.34658	.212	-.05502	1.146	.325	.752	.6519	-.0198	.334	1.000
16.750	1.662	1.59955	7.35530	1.407	-.02027	1.169	.377	.767	.6277	-.0203	.332	1.000
17.000	2.216	2.15333	7.37024	1.499	.01449	1.187	.417	.778	.6090	-.0214	.329	1.000
17.500	3.324	3.26108	7.39126	1.001	-.00013	1.193	.431	.783	.6022	-.0230	.326	1.000
18.000	4.432	4.36886	7.41069	1.009	-.00013	1.197	.441	.786	.5975	-.0246	.322	1.000
19.000	6.648	6.58423	7.45832	2.080	-.01403	1.197	.441	.786	.5975	-.0284	.313	1.000
20.000	8.864	8.79703	7.57358	3.873	-.01317	1.229	.512	.807	.5629	-.0386	.292	1.000
21.000	11.080	11.00568	7.75210	5.279	-.00864	1.264	.590	.829	.5238	-.0572	.258	1.000
22.000	13.295	13.21079	7.97045	5.859	-.00049	1.304	.679	.855	.4776	-.0841	.216	1.000
24.000	17.727	17.62415	8.37429	4.034	.01127	1.352	.786	.887	.4172	-.1438	.134	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=W2   (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	1975.6666
LOWER BOUNDARY PRESSURE FORCE	=	.0000
UPPER BOUNDARY PRESSURE FORCE	=	240.9012
SUM OF ABOVE		2216.5678
LEAVING MOMENTUM	=	2214.4419
ERROR	=	2.1259

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT • STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.32478	6.91388	.079	.00000	1.002	.005	.657	.7978	-.0000	.410	1.000
4.000	7.346	-21.97887	6.92512	.105	-.00013	1.010	.022	.662	.7901	.0000	.408	1.000
8.000	14.692	-14.63298	6.94664	.267	-.00064	1.023	.051	.671	.7768	.0002	.404	1.000
10.000	18.365	-10.96012	6.97179	.575	-.00228	1.037	.083	.680	.7626	.0005	.400	1.000
12.000	22.038	-7.28758	7.02619	1.156	-.00324	1.062	.138	.697	.7377	.0015	.391	1.000
13.000	23.874	-5.45171	7.07317	1.916	-.01120	1.080	.179	.709	.7190	.0028	.382	1.000
14.000	25.711	-3.61704	7.15381	3.129	-.01186	1.109	.243	.728	.6898	.0058	.368	1.000
14.500	26.629	-2.70059	7.21092	4.127	-.02607	1.128	.286	.740	.6699	.0085	.358	1.000
14.750	27.088	-2.24288	7.24690	4.883	-.03142	1.145	.324	.751	.6527	.0104	.352	1.000
15.000	27.547	-1.78571	7.28912	5.649	-.02682	1.161	.359	.762	.6362	.0130	.344	1.000
15.250	28.006	-1.32924	7.33827	6.787	-.05961	1.177	.394	.772	.6196	.0163	.335	1.000
15.500	28.465	-.87419	7.39912	8.493	-.07015	1.222	.495	.802	.5711	.0213	.324	1.000
15.625	28.695	-.64748	7.43520	9.677	-.10984	1.247	.550	.818	.5439	.0247	.318	1.000
15.750	28.925	-.42185	7.47743	11.724	-.20123	1.292	.652	.848	.4916	.0294	.310	1.000
15.875	29.154	-.19908	7.53252	16.910	-.58386	1.374	.836	.902	.3876	.0370	.300	1.000
16.000	29.384	.01540	7.61385	73.837	-4.56008	1.524	1.170	1.000	.0000	.0522	.284	1.000

TT/TTO = 1.000

ADDITIVE DRAG = .0522

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
16.000	.000	.01540	7.61385	73.837	-4.56008	1.524	1.170	1.000	.0000	.0522	.284	1.000
16.094	.108	.01011	7.71620	58.934	11.41643	.684	-.705	.449	1.1341	.0568	.265	1.000
16.187	.216	.09343	7.78277	27.107	2.07674	.538	-1.032	.353	1.3169	.0457	.252	1.000
16.375	.433	.29541	7.85990	17.202	.39732	.662	-.754	.434	1.1597	.0324	.237	1.000
16.563	.649	.50391	7.91790	14.371	.14198	.855	-.324	.561	.9479	.0263	.226	1.000
16.750	.866	.71431	7.96863	12.796	.10979	.873	-.283	.573	.9287	.0233	.216	1.000
17.125	1.299	1.13842	8.05510	10.527	.06264	.884	-.259	.580	.9176	.0186	.199	1.000
17.500	1.731	1.56489	8.12921	9.305	.03850	.898	-.229	.589	.9038	.0150	.184	1.000
18.250	2.597	2.42138	8.25522	7.436	.03372	.908	-.206	.596	.8933	.0095	.159	1.000
19.000	3.463	3.28117	8.35638	6.162	.01435	.929	-.159	.609	.8722	.0057	.138	1.000
20.500	5.194	5.00467	8.52207	4.909	.00998	.935	-.146	.613	.8662	.0004	.103	1.000
22.000	6.925	6.73089	8.65664	4.043	.00778	.944	-.124	.620	.8561	-.0034	.075	1.000
25.000	10.389	10.18795	8.85741	2.682	.00618	.946	-.120	.621	.8544	-.0087	.031	1.000
28.000	13.852	13.64853	8.98400	1.511	.00587	.949	-.113	.623	.8513	-.0120	.004	1.000
34.000	20.778	20.57396	9.05011	.121	-.00000	.984	-.035	.646	.8158	-.0131	-.011	1.000
40.000	27.704	27.49987	9.06430	.114	.00000	.998	-.005	.654	.8025	-.0131	-.014	1.000

TT/TTO = 1.000

B O U N D A R Y L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	.0154	.00000	.00000	.00000	0	.0000	.19929	.0000	.00000	.00408		.000000
2	.0101	.00023	.00044	.00257	57257	.0541	.00323	.1082	.00045	.00429		.000000
3	.0934	.00046	.00096	.00524	114324	.1317	.00610	.2164	.00093	.00532		.000000
4	.2954	.00118	.00226	.01321	229433	.4187	.00484	.4329	.00248	.00695		.165474
5	.5039	.00241	.00416	.02634	330419	.9820	.00340	.6493	.00394	.00573		.328849
6	.7143	.00294	.00502	.03206	437536	1.2535	.00376	.8658	.00496	.00430		.121025
7	1.1384	.00380	.00644	.04128	653490	1.7172	.00355	1.2986	.00646	.00324		.103916
8	1.5649	.00466	.00785	.05061	866462	2.2127	.00338	1.7315	.00777	.00303		.104942
9	2.4214	.00614	.01029	.06664	1293886	3.1170	.00317	2.5972	.01043	.00288		.114424
10	3.2812	.00781	.01294	.08447	1708660	4.1824	.00299	3.4630	.01276	.00262		.116682
11	5.0047	.01028	.01700	.11119	2555603	5.8929	.00280	5.1945	.01709	.00235		.079474
12	6.7309	.01280	.02106	.13824	3390566	7.7265	.00266	6.9259	.02088	.00211		.074819
13	10.1880	.01696	.02787	.18312	5081363	10.9781	.00247	10.3889	.02760	.00208		.041413
14	13.6485	.02103	.03451	.22699	6764468	14.3531	.00235	13.8519	.03528	.00220		.096167
15	20.5740	.03149	.05079	.33857	9950592	23.5439	.00215	20.7778	.05026	.00210		.129223
16	27.4999	.04019	.06441	.43149	13161809	31.8167	.00207	27.7037	.06441	.00198		.108227

TOTAL FRICTION DRAG= 27.20567

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 16.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-29.50895	60.02648	.172	.00000	1.002	.005	.657	.7978	-.0000	-43.484	1.000
4.000	7.313	-22.19637	60.04914	.188	-.00007	1.002	.004	.657	.7982	-.0001	-43.517	1.000
8.000	14.528	-14.98067	60.07478	.220	-.00008	1.001	.003	.657	.7985	-.0003	-43.555	1.000
10.000	18.077	-11.43161	60.08890	.236	-.00008	1.001	.003	.657	.7987	-.0004	-43.576	1.000
12.000	21.548	-7.96152	60.10366	.251	-.00007	1.001	.002	.657	.7990	-.0004	-43.598	1.000
14.000	24.862	-4.64679	60.11851	.262	-.00005	1.001	.002	.656	.7993	-.0004	-43.620	1.000
16.000	27.652	-1.85738	60.13146	.269	-.00003	1.000	.001	.656	.7996	-.0005	-43.639	1.000
19.000	31.554	2.04459	60.14993	.273	-.00000	1.000	-.000	.656	.8000	-.0005	-43.667	1.000
22.000	35.276	5.76669	60.16758	.270	.00003	1.000	-.001	.656	.8005	-.0005	-43.693	1.000
25.000	38.958	9.44893	60.18468	.262	.00005	.999	-.002	.655	.8008	-.0004	-43.718	1.000
28.000	42.617	13.10761	60.20104	.251	.00006	.999	-.003	.655	.8012	-.0004	-43.743	1.000
34.000	49.787	20.27753	60.23077	.223	.00007	.998	-.004	.655	.8017	-.0002	-43.787	1.000
40.000	56.766	27.25704	60.25678	.209	.00000	.998	-.005	.654	.8025	-.0001	-43.826	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=EXT (AXIAL FORCES ONLY)

```
ENTERING MOMENTUM                =146945.1278
LOWER BOUNDARY PRESSURE FORCE =      22.0031
UPPER BOUNDARY PRESSURE FORCE =        .0884
      SUM OF ABOVE                146967.2192
LEAVING MOMENTUM                 =146944.3956
      ERROR                      =      22.8237
```

********* END JOB *********

CARD INPUT

```
NAME=  DAVE FERGUSON
ADDRES= EVENDALE
IDENT=  LAHTI TEST CASE  DEC. 1ST,1972
1 STC          F              T
$A
MACHO=.663,
TSO=537.726,
PSO=10.9425,
AXI=F,
MAXIT=5,
RG=1716.2,VMG1=100.,VMG2=100.,SCON=198.6,
SGR(1)=1.0,
PPPFN=-1,
$
2 BDY          WALL          FLOW
$A
UPPER=T,ZRONLY=F,
B(1)=-16.0,9.0,0.0,
-9.0,9.0,0.0,
-8.0,9.0085,1.022,
-7.0,9.0373,2.327,
-6.0,9.0905,3.703,
-5.0,9.1640,4.672,
-4.0,9.2535,5.502,
-3.0,9.3503,5.273,
-2.0,9.4300,3.744,
-1.0,9.4812,2.139,
0.0,9.5053,0.667,
1.0,9.5072,-0.383,
2.0,9.4930,-1.237,
3.0,9.4653,-1.857,
4.0,9.4303,-2.153,
5.0,9.3887,-2.660,
6.064,9.3344,-3.059,
7.0,9.2867,-2.725,
8.0,9.2417,-2.474,
9.0,9.1991,-2.419,
10.0,9.1572,-2.372,
11.0,9.1171,-2.192,
12.0,9.0815,-1.860,
13.0,9.0526,-1.447,
14.0,9.0309,-1.038,
15.0,9.0160,-0.685,
16.0,9.0066,-0.405,
17.0,9.0015,-0.182,
18.0,9.0,0.0,
22.0,9.0,0.0,
$
2 BDY          BUMP          FLOW
$A
UPPER=F,ZRONLY=F,
BL=T,
B(1)=-16.0,0.0,0.0,
-6.064,0.0,0.0,
-6.0,.0005,0.844,
-5.5,.0347,6.801,
-5.0,.1165,11.551,
-4.5,.2350,14.822,
```

```
-4.0,.3755,16.237,
-3.5,.5196,15.567,
-3.364,.5568,15.038,
-3.0,.6492,13.405,
-2.5,.7577,11.086,
-2.0,.8453,8.810,
-1.5,.9129,6.594,
-1.0,.9611,4.405,
-0.5,.9900,2.210,
0.0,.9997,0.0,
0.5,.9900,-2.211,
1.0,.9611,-4.406,
1.5,.9129,-6.594,
2.0,.8453,-8.810,
2.5,.7577,-11.086,
3.0,.6492,-13.405,
3.364,.5568,-15.038,
3.5,.5196,-15.567,
4.0,.3755,-16.237,
4.5,.2350,-14.821,
5.0,.1165,-11.550,
5.5,.0347,-6.797,
6.0,.0005,-0.841,
6.064,0.0,0.0,
22.0,0.0,0.0,
$
3 CHN          FLOW
$A
VARY=F,
RG=1716.32,
TSO=537.726,
PSO=10.9425,
MACHO=.663,
$
1 STC          T             T
$A
MAXIT=5,
$
```

EXECUTING PROGM=STC
TAPIN= F TAPOT= T

BOUNDARY COORDINATES, BDY=WALL CHN=FLOW UPPER= T BL= F

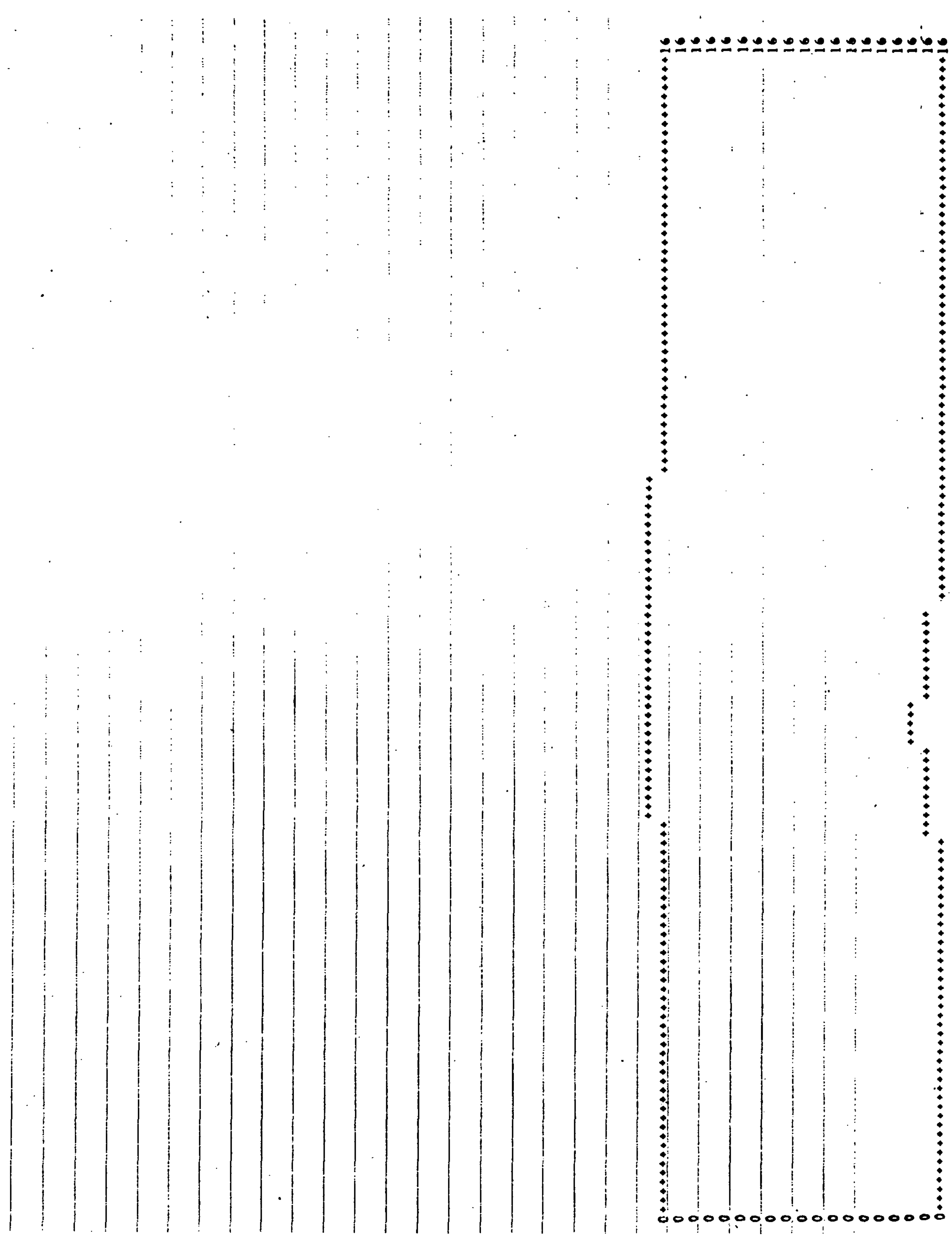
I	X,Z	Y,R	ANGD	CURV-	CURV+
1	-16.00000	9.00000	.000	.0000	.0000
2	-9.00000	9.00000	.000	.0000	-.0153
3	-8.00000	9.00850	1.022	-.0203	-.0202
4	-7.00000	9.03730	2.327	-.0254	-.0271
5	-6.00000	9.09050	3.703	-.0208	-.0186
6	-5.00000	9.16400	4.672	-.0152	-.0173
7	-4.00000	9.25350	5.502	-.0116	-.0108
8	-3.00000	9.35030	5.273	.0187	.0216
9	-2.00000	9.43000	3.744	.0316	.0291
10	-1.00000	9.48120	2.139	.0269	.0280
11	.00000	9.50530	.667	.0233	.0218
12	1.00000	9.50720	-.383	.0149	.0153
13	2.00000	9.49300	-1.237	.0145	.0150
14	3.00000	9.46530	-1.857	.0067	.0051
15	4.00000	9.43030	-2.153	.0052	.0063
16	5.00000	9.38870	-2.660	.0114	.0126
17	6.06400	9.33440	-3.059	.0004	-.0034
18	7.00000	9.28670	-2.725	-.0091	-.0068
19	8.00000	9.24170	-2.474	-.0020	-.0017
20	9.00000	9.19910	-2.419	-.0002	-.0004
21	10.00000	9.15720	-2.372	-.0012	-.0016
22	11.00000	9.11710	-2.192	-.0046	-.0044
23	12.00000	9.08150	-1.860	-.0071	-.0070
24	13.00000	9.05260	-1.447	-.0074	-.0071
25	14.00000	9.03090	-1.038	-.0072	-.0070
26	15.00000	9.01600	-.685	-.0053	-.0056
27	16.00000	9.00660	-.405	-.0042	-.0040
28	17.00000	9.00150	-.182	-.0038	-.0037
29	18.00000	9.00000	.000	-.0026	.0000
30	22.00000	9.00000	.000	.0000	.0000

IDENT= LAHTI TEST CASE DEC. 1ST,1972

B O U N D A R Y C O O R D I N A T E S, BDY=BUMP CHN=FLOW UPPER= F BL= T

I	X,Z	Y,R	ANGD	CURV-	CURV+
1	-16.00000	.00000	.000	.0000	.0000
2	-6.06400	.00000	.000	.0000	-.2720
3	-6.00000	.00050	.844	-.1882	-.2254
4	-5.50000	.03470	6.801	-.1878	-.1869
5	-5.00000	.11650	11.551	-.1395	-.1408
6	-4.50000	.23500	14.822	-.0811	-.0810
7	-4.00000	.37550	16.237	-.0141	-.0127
8	-3.50000	.51960	15.567	.0577	.0689
9	-3.36400	.55680	15.038	.0621	.0697
10	-3.00000	.64920	13.405	.0820	.0795
11	-2.50000	.75770	11.086	.0786	.0804
12	-2.00000	.84530	8.810	.0760	.0771
13	-1.50000	.91290	6.594	.0761	.0746
14	-1.00000	.96110	4.405	.0774	.0763
15	-.50000	.99000	2.210	.0766	.0757
16	.00000	.99970	.000	.0784	.0784
17	.50000	.99000	-2.211	.0759	.0763
18	1.00000	.96110	-4.406	.0766	.0773
19	1.50000	.91290	-6.594	.0747	.0761
20	2.00000	.84530	-8.810	.0771	.0760
21	2.50000	.75770	-11.086	.0804	.0786
22	3.00000	.64920	-13.405	.0795	.0820
23	3.36400	.55680	-15.038	.0697	.0621
24	3.50000	.51960	-15.567	.0689	.0577
25	4.00000	.37550	-16.237	-.0127	-.0140
26	4.50000	.23500	-14.821	-.0811	-.0809
27	5.00000	.11650	-11.550	-.1410	-.1391
28	5.50000	.03470	-6.797	-.1875	-.1871
29	6.00000	.00050	-.841	-.2261	-.1850
30	6.06400	.00000	.000	-.2737	.0000
31	22.00000	.00000	.000	.0000	.0000

XI1,XI2 GRID MAP



IDENT= LAHTI TEST CASE DEC. 1ST.1972

SOLUTION HISTORY

REFINEMENT		INNER ITERS		MATRIX SOLUTION			FLOW BALANCE ERROR			KUTTA ITERATION		
NREFIN	GRID PTS	INRCTR	NSSPTS	NSWEEPS	MAX-DS2	MAX-ES2	LIM-ES2	Z	R	TRAILING EDGE-XI2	FLOW RATE	FRACTIONAL FLOW ERROR
0	4	0	0	0	*0.000000	-.000000	.500000	22.000	9.000			
0	4	1	0	1	.000000	-.000000	.500000	-16.000	9.000			
1	9	0	0	0	*0.000000	-.078660	1.900000	3.355	5.060			
1	9	1	0	2	-.075489	-.012804	1.900000	3.504	4.984			
2	25	0	0	0	*0.000000	-.287988	.933548	12.643	4.831			
2	25	1	0	4	-.248132	.017314	.933548	3.231	4.930			
3	81	0	0	0	*0.000000	.420298	.462779	-1.735	2.564			
3	81	1	0	6	.333681	.033511	.462779	-1.901	2.888			
4	289	0	0	0	*0.000000	-.177064	.222895	5.435	1.433			
4	289	1	0	10	-.103756	.017075	.222895	.741	3.518			
5	594	0	0	0	*0.000000	-.053881	.001000	-5.480	2.480			
5	594	1	0	18	-.023772	.003876	.001000	-3.267	2.763			
5	594	2	0	18	.001802	-.002419	.001000	-3.602	6.001			
5	594	3	0	19	-.000910	-.000179	.001000	-3.507	4.916			

*** THE INPUT GRID REFINEMENT CRITERIA HAVE NOT BEEN SATISFIED.

```
IDENT=  LAHTI TEST CASE  DEC. 1ST.1972

GENERAL INPUT-
      AXI    =         F                          MACHO =    .6630
      PG     = 1716.20                            TSO   =   537.73
      GAM    =  1.4000                            PSO   =   10.942
      TTE    =    .000                            PTO   =   14.696
      CHOTST=         T                           TTO   =   585.00
      CG     =  32.174

STREAMLINE END CONDITIONS-
      NBCIN  =        2        2
      ACF    =     .000     .000

CURVATURE CALCULATION FOR SUPERSONIC FLOW-
      SSFML  =        1   (FORMULA NUMBER)
      SSEANG=      .000   (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)

SUBSONIC/SUPERSONIC BRANCH SELECTION-
      SSEF   =        F   (SUPERSONIC ENTERING FLOW, T OR F)
      SSDF   =        F   (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION, T OR F)

GRID SIZE CRITERIA-
      NGR/GR=*0000.00
      SGR    =     1.00

      VMG1   =   100.00                          VMG2  =  100.00

      CRX    =     .375     .375     .125     .000     .000     .000

MEMORY UTILIZATION-
                              USED    AVAILABLE
      GRID POINTS              594       768
      TABLES                   895      2200
      STREAMLINES               18       128

CONVERGENCE DATA-
      MAXREF=         5   (MAXIMUM REFINEMENTS)
      NREFIN=         5 - NUMBER OF REFINEMENTS
      INRCTR=         3 - NUMBER OF ITERATIONS IN LAST REFINEMENT

      TOLINR= 5.0E-02   (INNER ITERATION TOLERANCE ON S.L. MOVEMENT)
      TOLES2= 1.0E-03   (FINAL TOLERANCE ON S.L. MOVEMENT)
      TOLWF = 1.0E-03   (T.E. CLOSURE FRACTIONAL FLOW TOLERANCE)
      CLEN  =   1.000 - CHARACTERISTIC LENGTH BASED ON GRID SIZE CRITERIA
                1.0E-03 - ABSOLUTE TOLERANCE ON S.L. MOVEMENT (=TOLES2*CLEN)
      MAXES2=-1.8E-04 - LARGEST S.L. MOVEMENT ON LAST ITERATION

      DSIDMP=    .020   (STREAMWISE PT MOVEMENT DAMPING, =0 FOR NO DAMPING)
      DSIDP1=    .500   (ADDITIONAL STREAMWISE DAMPING ON FIRST PASS ONLY)
      NODENS=       0   (REFINEMENT LEVEL TO WHICH CONSTANT DENSITY IS ASSUMED)
      RHOC  =   1.000   RHOW  =  1.000   RHOCSS=  1.000   RHOWSS=  1.000   (CORRECTION EQ. DECEL. FACTORS)
```

```
IDENT=  LAHTI TEST CASE  DEC. 1ST,1972

SPECIAL BOUNDARY OPTIONS-
        FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
        IADM   =        0   (=-1,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION)
        RHORAS=      .500   (ACCELERATION FACTOR, BASE LEVEL)
        RHOAMP=      .500   (ACCELERATION FACTOR, AMPLITUDE OF VARIATION)
        TOLRL  = 1.0E-03    (TOLERANCE RELATIVE TO MAXDS2)

        HIGHLIGHT RADIUS=     .000    HIGHLIGHT AREA=     .000
        MAX. BODY RADIUS=     .000    MAX. BODY AREA=     .000
        MASS FLOW RATIO =*000.000

CONTENTS OF CHANNEL TABLE-

        CHN    =  FLOW         WTFLOW=  1.0000E+15
        TTO    =*0000.00       PTO    =*000.000      TSO   =  537.73     PSO    =  10.942
        MACHO  =   .6630       AO     =  1.0000E+15 VARY  =        F
        PG     = 1716.32       GAM    =*00.0000

CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-

                     SPECIFIED     ADJUSTED       PT/PSO       TT/TSO
        FLOW           .0804         .0804        14.6959     584.9995
```

IDENT= LAHTI TEST CASE DEC. 1ST,1972

LOWER BOUNDARY TO CHN=FLOW . STREAMLINE COORDINATE. XI2= .000.

XI1	SIW	XW.ZW	YW.RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-15.83077	.00000	.000	.00000	1.000	.000	.745	.6630	I	I	1.000
.500	1.183	-14.64735	.00000	.000	.00000	1.001	.003	.745	.6618	I	I	1.000
1.000	2.367	-13.46394	.00000	.000	.00000	1.002	.008	.746	.6603	I	I	1.000
1.500	3.550	-12.28052	.00000	.000	.00000	1.004	.014	.748	.6578	I	I	1.000
2.000	4.734	-11.09711	.00000	.000	.00000	1.008	.025	.750	.6539	I	I	1.000
2.500	5.917	-9.91369	.00000	.000	.00000	1.013	.044	.755	.6472	I	I	1.000
3.000	7.100	-8.73028	.00000	.000	.00000	1.023	.076	.762	.6353	I	I	1.000
3.500	8.284	-7.54686	.00000	.000	.00000	1.040	.129	.774	.6158	I	I	1.000
4.000	9.467	-6.36346	.00000	.000	.00000	1.084	.272	.807	.5620	I	I	1.000
4.500	10.651	-5.18396	.08151	9.957	-.15738	1.124	.403	.837	.5108	R	R	1.000
5.000	11.834	-4.03584	.36507	16.202	-.01891	1.028	.090	.765	.6304	R	R	1.000
5.500	13.018	-2.89363	.67406	12.908	.07934	.880	-.390	.655	.8013	R	R	1.000
6.000	14.201	-1.72951	.88431	7.606	.07662	.790	-.684	.588	.9053	R	R	1.000
6.500	15.384	-.55103	.98793	2.434	.07655	.741	-.842	.552	.9623	R	R	1.000
7.000	16.568	.63196	.98424	-2.789	.07644	.754	-.799	.562	.9466	R	R	1.000
7.500	17.751	1.80978	.87334	-7.962	.07677	.817	-.596	.608	.8738	R	R	1.000
8.000	18.935	2.97254	.65571	-13.276	.07946	.911	-.291	.678	.7662	R	R	1.000
8.500	20.118	4.11365	.34254	-16.090	-.02932	1.052	.170	.784	.6006	R	R	1.000
9.000	21.301	5.26382	.06802	-9.210	-.16516	1.137	.447	.847	.4930	R	R	1.000
9.500	22.485	6.44426	.00000	.000	.00000	1.093	.304	.814	.5501	R	I	1.000
10.000	23.668	7.62767	.00000	.000	.00000	1.055	.180	.786	.5970	R	I	1.000
10.500	24.852	8.81109	.00000	.000	.00000	1.039	.128	.774	.6162	R	I	1.000
11.000	26.035	9.99451	.00000	.000	.00000	1.028	.093	.766	.6293	R	I	1.000
11.500	27.219	11.17792	.00000	.000	.00000	1.021	.068	.760	.6385	R	I	1.000
12.000	28.402	12.36134	.00000	.000	.00000	1.015	.049	.756	.6453	R	I	1.000
12.500	29.585	13.54475	.00000	.000	.00000	1.011	.034	.752	.6505	R	I	1.000
13.000	30.769	14.72817	.00000	.000	.00000	1.007	.024	.750	.6545	R	I	1.000
13.500	31.952	15.91158	.00000	.000	.00000	1.005	.016	.748	.6573	R	I	1.000
14.000	33.136	17.09500	.00000	.000	.00000	1.003	.010	.747	.6594	R	I	1.000
14.500	34.319	18.27842	.00000	.000	.00000	1.002	.006	.746	.6608	R	I	1.000
15.000	35.502	19.46183	.00000	.000	.00000	1.001	.003	.745	.6618	R	I	1.000
15.500	36.686	20.64525	.00000	.000	.00000	1.000	.001	.745	.6625	R	I	1.000
16.000	37.869	21.82866	.00000	.000	.00000	1.000	.000	.745	.6630	R	I	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	-15.8308	.00000	.00000	.00000	0	.0000	.00621	.0000	.00000	.00422		.000000
2	-14.6474	.00326	.00490	.03456	330487	1.1870	.00479	1.1834	.00466	.00365		.000000
3	-13.4639	.00570	.00857	.06040	659978	2.3845	.00387	2.3668	.00863	.00307		.000535
4	-12.2805	.00794	.01192	.08411	987636	3.6048	.00355	3.5502	.01192	.00276		.002032
5	-11.0971	.01013	.01516	.10716	1311684	4.8749	.00334	4.7337	.01515	.00277		.005868
6	-9.9137	.01238	.01849	.13093	1628641	6.2516	.00319	5.9171	.01847	.00282		.015398
7	-8.7303	.01494	.02220	.15791	1930685	7.8770	.00309	7.1005	.02183	.00379		.038240
8	-7.5469	.01821	.02684	.19214	2205470	10.0135	.00324	8.2839	.02743	.00785		.103830
9	-6.3635	.02584	.03726	.27140	2362032	15.1713	.00308	9.4673	.04042	.00713		.265999
10	-5.1840	.03639	.05146	.38077	2471930	22.7506	.00470	10.6507	.04431	-.00258		.392400
11	-4.0358	.02059	.03054	.21752	3201097	11.7399	.00281	11.8342	.03432	-.01042		.000000
12	-2.8936	.01187	.01901	.12743	4054816	6.2331	.00217	13.0176	.01965	-.00746		.000000
13	-1.7295	.01025	.01727	.11129	4665552	5.3327	.00297	14.2010	.01667	-.00062		.000000
14	-.5510	.01051	.01824	.11492	5161217	5.5806	.00298	15.3844	.01819	.00213		.000000

15	.6320	.01271	.02188	.13875	5529109	7.0530	.00302	16.5678	.02170	.00383		.021236
16	1.8098	.01733	.02876	.18753	5751219	10.2031	.0031[illegible]	17.7512	.02726	.00918		.168948
17	2.9725	.02635	.04151	.28185	5764023	16.7159	.00475	18.9347	.04344	.02676		.424113
18	4.1136	.05480	.08025	.57737	5264179	39.4463	.00214	20.1181	.09059	.03323	SEP	.703401
19	5.2638	.10150	.14262	1.06089	4807564	81.3232	-.00191	21.3015	.12209	.01069	SEP	.745182
20	6.4443	.07362	.10566	.77256	5521250	55.8728	.00060	22.4849	.11588	-.01495	SEP	.000000
21	7.6277	.05876	.08592	.61886	6166678	42.9740	.00126	23.6683	.08670	-.01525	SEP	.000000
22	8.8111	.05474	.08068	.57749	6619371	39.6319	.00201	24.8517	.07978	-.00362	SEP	.000000
23	9.9945	.05274	.07816	.55699	7034411	38.0165	.00211	26.0351	.07812	-.00112	SEP	.000000
24	11.1779	.05186	.07716	.54817	7425134	37.3552	.00215	27.2186	.07712	-.00050	SEP	.000000
25	12.3613	.05157	.07695	.54541	7802906	37.1863	.00217	28.4020	.07695	.00007	SEP	.000000
26	13.5448	.05169	.07729	.54686	8170832	37.3585	.00218	29.5854	.07729	.00046	SEP	.000000
27	14.7282	.05209	.07803	.55134	8531001	37.7787	.00218	30.7688	.07803	.00076	SEP	.000000
28	15.9116	.05273	.07909	.55824	8884375	38.3975	.00218	31.9522	.07909	.00100	SEP	.000000
29	17.0950	.05355	.08039	.56703	9231938	39.1746	.00217	33.1356	.08039	.00118	SEP	.000000
30	18.2784	.05451	.08188	.57724	9574863	40.0720	.00217	34.3191	.08188	.00131	SEP	.000000
31	19.4618	.05556	.08350	.58845	9914306	41.0566	.00216	35.5025	.08350	.00140	SEP	.000000
32	20.6452	.05668	.08519	.60028	10251473	42.0978	.00215	36.6859	.08520	.00145	SEP	.000000
33	21.8287	.05782	.08693	.61238	10587595	43.1666	.00214	37.8693	.08693	.00147	SEP	.000000

TOTAL FRICTION DRAG= .35015

IDENT= LAHTI TEST CASE DEC. 1ST,1972

UPPER BOUNDARY TO CHN=FLOW , STREAMLINE COORDINATE, XI2= 8.000,

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-15.84291	9.00000	.000	-.00000	1.000	.000	.745	.6630	I	R	1.000
.500	1.181	-14.66142	9.00000	.000	-.00000	.999	-.003	.744	.6642	R	R	1.000
1.000	2.358	-13.48442	9.00000	.000	-.00000	.998	-.008	.743	.6658	R	R	1.000
1.500	3.529	-12.31401	9.00000	.000	.00000	.996	-.015	.741	.6682	R	R	1.000
2.000	4.689	-11.15416	9.00000	.000	.00000	.992	-.026	.739	.6725	R	R	1.000
2.500	5.831	-10.01219	9.00000	.000	.00000	.985	-.047	.734	.6800	R	R	1.000
3.000	6.939	-8.90349	9.00007	.086	-.01581	.969	-.101	.722	.6991	R	R	1.000
3.500	7.994	-7.84888	9.01143	1.200	-.02095	.952	-.156	.709	.7186	R	R	1.000
4.000	8.973	-6.87099	9.04277	2.525	-.02633	.943	-.186	.702	.7293	R	R	1.000
4.500	9.853	-5.99187	9.09103	3.712	-.01853	.943	-.184	.702	.7286	R	R	1.000
5.000	10.797	-5.05068	9.15988	4.628	-.01535	.948	-.169	.706	.7235	R	R	1.000
5.500	11.977	-3.87472	9.26564	5.566	-.00708	.964	-.116	.718	.7045	R	R	1.000
6.000	13.414	-2.44394	9.39796	4.494	.02717	.997	-.011	.742	.6669	R	R	1.000
6.500	15.020	-.84133	9.48678	1.887	.02728	1.004	.013	.748	.6584	R	R	1.000
7.000	16.659	.79750	9.50824	-.202	.01626	.999	-.002	.744	.6638	R	R	1.000
7.500	18.225	2.36360	9.48422	-1.518	.01195	.999	-.003	.744	.6642	R	R	1.000
8.000	19.656	3.79374	9.43794	-2.091	.00519	1.002	.006	.746	.6608	R	R	1.000
8.500	20.879	5.01601	9.38795	-2.672	.01245	1.009	.029	.751	.6524	R	R	1.000
9.000	21.875	6.01086	9.33724	-3.057	.00105	1.006	.020	.749	.6557	R	R	1.000
9.500	22.818	6.95254	9.28897	-2.749	-.00877	1.004	.012	.747	.6588	R	R	1.000
10.000	23.862	7.99500	9.24192	-2.475	-.00200	1.007	.022	.750	.6550	R	R	1.000
10.500	24.965	9.09708	9.19500	-2.416	-.00050	1.008	.025	.750	.6538	R	R	1.000
11.000	26.093	10.22483	9.14793	-2.347	-.00231	1.005	.016	.748	.6573	R	R	1.000
11.500	27.233	11.36337	9.10351	-2.089	-.00542	.999	-.002	.744	.6636	R	R	1.000
12.000	28.376	12.50605	9.06597	-1.654	-.00721	.995	-.017	.741	.6690	R	R	1.000
12.500	29.523	13.65242	9.03763	-1.181	-.00716	.992	-.025	.739	.6720	R	R	1.000
13.000	30.674	14.80372	9.01845	-.747	-.00566	.992	-.026	.739	.6724	R	R	1.000
13.500	31.832	15.96115	9.00688	-.414	-.00427	.993	-.023	.739	.6714	R	R	1.000
14.000	32.995	17.12473	9.00113	-.156	-.00357	.994	-.019	.740	.6698	R	R	1.000
14.500	34.166	18.29508	9.00000	.000	-.00000	.997	-.009	.742	.6663	R	R	1.000
15.000	35.343	19.47181	9.00000	.000	-.00000	.999	-.004	.744	.6645	R	R	1.000
15.500	36.523	20.65207	9.00000	.000	.00000	.999	-.002	.744	.6636	R	R	1.000
16.000	37.705	21.83454	9.00000	.000	.00000	1.000	.000	.745	.6630	R	R	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=FLOW (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	60.6057
LOWER BOUNDARY PRESSURE FORCE	=	.1874
UPPER BOUNDARY PRESSURE FORCE	=	-.1866
SUM OF ABOVE		60.6065
LEAVING MOMENTUM	=	60.6058
ERROR	=	.0008

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EXECUTING PROGM=STC
TAPIN= T     TAPOT= T
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IDENT=  LAHTI TEST CASE  DEC. 1ST,1972

                                                        SOLUTION    HISTORY
                                                       --------------------
 REFINEMENT   +  INNER ITERS  +  MATRIX  SOLUTION  +   -  -    FLOW  BALANCE  ERROR     -  -  +        KUTTA   ITERATION
                                                                                              TRAILING    FLOW     FRACTIONAL
 NREFIN   GRID   INRCTR  NSSPTS  NSWEEPS   MAX-DS2    MAX-ES2    LIM-ES2      Z         R     EDGE-XI2    RATE     FLOW ERROR
          PTS

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068

     * * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP     SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068

* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068

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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068

* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068

* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068

* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068

* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
 5    594    0    0    0   *0.000000   .113540   .001000   5.313   .396
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=     20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
  5    594    1    0    15    .107698   -.004543    .001000    4.614    3.807
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
  5     594     2     0     24    -.002750   .002599   .001000    4.660    4.362
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP    SW=    20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
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* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
* * W A R N I N G * *     SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068
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* * W A R N I N G * *      SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068

* * W A R N I N G * *      SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068

* * W A R N I N G * *      SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068

* * W A R N I N G * *      SEPARATED BL  ,  BOUNDARY= BUMP     SW=     20.118068

    5    594     3     0     21    .001125   -.000087    .001000     6.699      4.217

***  THE INPUT GRID REFINEMENT CRITERIA HAVE NOT BEEN SATISFIED.
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```
IDENT=  LAHTI TEST CASE  DEC. 1ST,1972

GENERAL INPUT-
     AXI    =        F                              MACHO =    .6630
     RG     = 1716.20                               TSO   =  537.73
     GAM    =  1.4000                               PSO   =  10.942
     TTE    =    .000                               PTO   =  14.696
     CHOTST=         T                              TTO   =  585.00
     CG     =  32.174

STREAMLINE END CONDITIONS-
     NBCIN =         2          2
     ACF    =     .000       .000

CURVATURE CALCULATION FOR SUPERSONIC FLOW-
     SSFML =         1    (FORMULA NUMBER)
     SSEANG=      .000    (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)

SUBSONIC/SUPERSONIC BRANCH SELECTION-
     SSEF  =         F    (SUPERSONIC ENTERING FLOW, T OR F)
     SSDF  =         F    (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION, T OR F)

GRID SIZE CRITERIA-
     NGR/GR=*0000.00
     SGR   =      1.00

     VMG1  =* 100.00                                VMG2  =  100.00

     CPX   =      .375      .375      .125     .000      .000      .000

MEMORY UTILIZATION-
                          USED      AVAILABLE
     GRID POINTS           594         768
     TABLES               1000        2200
     STREAMLINES            18         128

CONVERGENCE DATA-
     MAXREF=         5    (MAXIMUM REFINEMENTS)
     NREFIN=         5 -  NUMBER OF REFINEMENTS
     INRCTR=         3 -  NUMBER OF ITERATIONS IN LAST REFINEMENT

     TOLINR= 5.0E-02      (INNER ITERATION TOLERANCE ON S.L. MOVEMENT)
     TOLES2= 1.0E-03      (FINAL TOLERANCE ON S.L. MOVEMENT)
     TOLWF = 1.0E-03      (T.E. CLOSURE FRACTIONAL FLOW TOLERANCE)
     CLEN  =     1.000 -  CHARACTERISTIC LENGTH BASED ON GRID SIZE CRITERIA
               1.0E-03 -  ABSOLUTE TOLERANCE ON S.L. MOVEMENT (=TOLES2*CLEN)
     MAXES2=-8.7E-05 -    LARGEST S.L. MOVEMENT ON LAST ITERATION

     DSIDMP=      .020    (STREAMWISE PT MOVEMENT DAMPING, =0 FOR NO DAMPING)
     DSIDP1=      .500    (ADDITIONAL STREAMWISE DAMPING ON FIRST PASS ONLY)
     MODENS=         0    (REFINEMENT LEVEL TO WHICH CONSTANT DENSITY IS ASSUMED)
     RHOC  =     1.000    RHOW   =  1.000    RHOCSS=  1.000    RHOWSS=  1.000    (CORRECTION EQ. DECEL. FACTORS)
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```
IDENT=  LAHTI TEST CASE  DEC. 1ST,1972

SPECIAL POUNDARY OPTIONS-
         FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
         IADM   =        0    (=-1,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION)
         RHOBAS=      .500    (ACCELERATION FACTOR, BASE LEVEL)
         RHOAMP=      .500    (ACCELERATION FACTOR, AMPLITUDE OF VARIATION)
         TOLRL = 1.0E-03      (TOLERANCE RELATIVE TO MAXDS2)

         HIGHLIGHT RADIUS=     .000    HIGHLIGHT AREA=     .000
         MAX. BODY RADIUS=     .000    MAX. BODY AREA=     .000
         MASS FLOW RATIO =*000.000

CONTENTS OF CHANNEL TABLE-

         CHN    =  FLOW        WTFLOW=  1.0000E+15
         TTO    =*0000.00      PTO    =*000.000     TSO    =  537.73     PSO    *  10.942
         MACHO  =    .6630     AO     =  1.0000E+15 VARY   =             F
         PG     = 1716.32      GAM    =*00.0000

CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-

                      SPECIFIED     ADJUSTED        PT/PSO        TT/TSO
         FLOW           .0804         .0804        14.6959       584.9995
```

IDENT= LAHTI TEST CASE DEC. 1ST,1972

LOWER BOUNDARY TO CHN=FLOW . STREAMLINE COORDINATE, XI2= .000.

XI1	SIW	XW.ZW	YW.RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-15.83077	.00067	.237	.00000	1.000	-.000	.745	.6631	I	R	1.000
.500	1.183	-14.64823	.00522	.204	.00000	1.000	-.000	.745	.6631	R	R	1.000
1.000	2.365	-13.46569	.00909	.173	.00000	1.001	.003	.745	.6621	R	R	1.000
1.500	3.548	-12.28315	.01238	.158	.00000	1.003	.009	.747	.6598	R	R	1.000
2.000	4.730	-11.10061	.01562	.159	.00000	1.006	.019	.749	.6561	R	R	1.000
2.500	5.913	-9.91806	.01894	.169	.00000	1.011	.037	.753	.6497	R	R	1.000
3.000	7.095	-8.73552	.02261	.249	.00000	1.022	.070	.761	.6375	R	R	1.000
3.500	8.278	-7.55299	.02922	.444	.00000	1.037	.120	.772	.6192	R	R	1.000
4.000	9.460	-6.37051	.04095	.332	.00000	1.074	.242	.800	.5737	R	R	1.000
4.500	10.643	-5.19180	.12366	9.740	-.15744	1.116	.376	.831	.5218	R	R	1.000
5.000	11.825	-4.04196	.39681	15.632	-.01857	1.020	.066	.760	.6390	R	R	1.000
5.500	13.008	-2.89722	.69296	12.534	.07934	.883	-.381	.657	.7981	R	R	1.000
6.000	14.191	-1.73348	.90082	7.601	.07662	.791	-.679	.589	.9034	R	R	1.000
6.500	15.373	-.55603	1.00641	2.568	.07655	.740	-.844	.551	.9630	R	R	1.000
7.000	16.556	.62612	1.00701	-2.497	.07643	.754	-.798	.562	.9465	R	R	1.000
7.500	17.738	1.80381	.90391	-7.257	.07675	.821	-.580	.612	.8684	R	R	1.000
8.000	18.921	2.96964	.70741	-11.634	.07944	.910	-.291	.678	.7665	R	R	1.000
8.500	20.103	4.12120	.43886	-14.380	-.02718	1.026	.086	.764	.6319	R	R	1.000
9.000	21.286	5.27640	.18879	-8.859	-.16457	1.115	.372	.830	.5231	R	R	1.000
9.500	22.468	6.45574	.11142	-.859	.00000	1.073	.238	.799	.5752	R	R	1.000
10.000	23.651	7.63799	.08564	-.773	.00000	1.052	.168	.783	.6016	R	R	1.000
10.500	24.834	8.82052	.07952	-.186	.00000	1.033	.107	.769	.6241	R	R	1.000
11.000	26.016	10.00306	.07797	-.059	.00000	1.021	.068	.760	.6385	R	R	1.000
11.500	27.199	11.18561	.07709	-.024	.00000	1.013	.041	.754	.6480	R	R	1.000
12.000	28.381	12.36816	.07700	.007	.00000	1.007	.021	.749	.6553	R	R	1.000
12.500	29.564	13.55071	.07740	.029	.00000	1.002	.006	.746	.6610	R	R	1.000
13.000	30.746	14.73325	.07819	.046	.00000	.998	-.006	.743	.6653	R	R	1.000
13.500	31.929	15.91580	.07928	.059	.00000	.995	-.015	.741	.6685	R	R	1.000
14.000	33.111	17.09835	.08061	.069	.00000	.993	-.022	.740	.6709	R	R	1.000
14.500	34.294	18.28090	.08211	.076	.00000	.992	-.027	.738	.6727	R	R	1.000
15.000	35.476	19.46344	.08374	.081	.00000	.991	-.031	.738	.6740	R	R	1.000
15.500	36.659	20.64599	.08545	.083	.00000	.990	-.034	.737	.6752	R	R	1.000
16.000	37.842	21.82854	.08693	.084	.00000	.989	-.036	.736	.6758	R	R	1.000

TT/TTO = 1.000

B O U N D A R Y L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	-15.9338	.00000	.00000	.00000	0	.0000	.00621	.0000	.00000	.00421		.000000
2	-14.6482	.00325	.00489	.03445	330640	1.1827	.00479	1.1825	.00464	.00364		.000000
3	-13.4657	.00568	.00854	.06017	660645	2.3742	.00387	2.3651	.00860	.00306		.000309
4	-12.2831	.00792	.01189	.08382	988789	3.5910	.00355	3.5476	.01188	.00275		.001608
5	-11.1006	.01008	.01512	.10674	1313624	4.8533	.00334	4.7302	.01510	.00276		.004987
6	-9.9181	.01232	.01842	.13033	1631553	6.2198	.00319	5.9127	.01842	.00286		.014077
7	-8.7355	.01490	.02216	.15744	1933655	7.8525	.00309	7.0953	.02187	.00360		.036338
8	-7.5530	.01806	.02665	.19054	2212090	9.9186	.00316	8.2778	.02694	.00714		.092690
9	-6.3705	.02453	.03554	.25791	2395905	14.2880	.00315	9.4604	.03875	.00650		.231681
10	-5.1918	.03454	.04904	.36170	2510983	21.4227	.00444	10.6429	.04231	-.00223		.374699
11	-4.0420	.02010	.02991	.21246	3227866	11.4256	.00269	11.8255	.03346	-.00946		.000000
12	-2.8972	.01216	.01945	.13052	4043921	6.4195	.00229	13.0080	.01993	-.00695		.000000
13	-1.7335	.01049	.01752	.11296	4658355	5.4321	.00284	14.1906	.01702	-.00069		.000000
14	-.5560	.01057	.01835	.11561	5158573	5.6224	.00297	15.3731	.01829	.00209		.000000

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
16	1.6038	.01769	.02927	.19128	5732107	10.4517	.00308	17.7382	.02843	.00853		.180137
17	2.9696	.02641	.04162	.28255	5760782	16.7689	.00380	18.9208	.04712	.02156		.402860
18	4.1212	.04747	.07042	.50140	5446528	33.3570	.00334	20.1033	.07942	.02637	SEP	.625126
19	5.2764	.08530	.12119	.89344	5032007	66.3726	-.00110	21.2859	.10449	.01031	SEP	.733012
20	6.4557	.06512	.09439	.68468	5700803	48.4390	.00086	22.4684	.10381	-.00869	SEP	.000000
21	7.6380	.05818	.08524	.61304	6195398	42.5267	.00187	23.6510	.08394	-.01039	SEP	.000000
22	8.8205	.05345	.07905	.56428	6671831	38.5853	.00198	24.8335	.07923	-.00325	SEP	.000000
23	10.0031	.05128	.07630	.54202	7097415	36.8325	.00211	26.0161	.07624	-.00168	SEP	.000000
24	11.1856	.05042	.07533	.53339	7492572	36.1886	.00216	27.1986	.07525	-.00049	SEP	.000000
25	12.3682	.05011	.07509	.53039	7875831	36.0002	.00218	28.3811	.07509	.00006	SEP	.000000
26	13.5507	.05019	.07540	.53155	8249205	36.1483	.00218	29.5637	.07539	.00043	SEP	.000000
27	14.7333	.05056	.07610	.53567	8614968	36.5373	.00219	30.7462	.07610	.00072	SEP	.000000
28	15.9158	.05116	.07710	.54214	8974106	37.1185	.00218	31.9288	.07710	.00095	SEP	.000000
29	17.0983	.05193	.07834	.55039	9327829	37.8475	.00218	33.1113	.07834	.00113	SEP	.000000
30	18.2809	.05283	.07977	.56004	9676980	38.6947	.00217	34.2939	.07977	.00125	SEP	.000000
31	19.4634	.05382	.08131	.57063	10022894	39.6239	.00216	35.4764	.08129	.00133	SEP	.000000
32	20.6460	.05484	.08289	.58146	10368153	40.5772	.00216	36.6590	.08292	.00140	SEP	.000000
33	21.8285	.05596	.08461	.59341	10709064	41.6282	.00215	37.8415	.08461	.00146	SEP	.000000

TOTAL FRICTION DRAG= .35782

IDENT= LAHTI TEST CASE DEC. 1ST.1972

UPPER BOUNDARY TO CHN=FLOW , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW.ZW	YW.RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-15.85826	9.00000	.000	-.00000	1.000	-.000	.745	.6631	I	R	1.000
.500	1.181	-14.67705	9.00000	.000	-.00000	.998	-.005	.743	.6648	R	R	1.000
1.000	2.358	-13.49978	9.00000	.000	-.00000	.997	-.011	.742	.6669	R	R	1.000
1.500	3.529	-12.32935	9.00000	.000	.00000	.994	-.019	.740	.6699	R	R	1.000
2.000	4.688	-11.16990	9.00000	.000	.00000	.990	-.032	.737	.6746	R	R	1.000
2.500	5.839	-10.02856	9.00000	.000	.00000	.983	-.054	.732	.6825	R	R	1.000
3.000	6.937	-8.92103	9.00005	.070	-.01572	.967	-.109	.720	.7020	R	R	1.000
3.500	7.991	-7.86746	9.01104	1.178	-.02085	.949	-.166	.707	.7222	R	R	1.000
4.000	8.976	-6.88294	9.04224	2.507	-.02640	.939	-.198	.699	.7336	R	R	1.000
4.500	9.869	-5.99097	9.09109	3.713	-.01852	.940	-.196	.700	.7330	R	R	1.000
5.000	10.823	-5.04011	9.16073	4.637	-.01531	.944	-.183	.703	.7282	R	R	1.000
5.500	12.000	-3.86706	9.26639	5.569	-.00685	.960	-.129	.715	.7091	R	R	1.000
6.000	13.423	-2.45037	9.39745	4.504	.02711	.993	-.024	.739	.6715	R	R	1.000
6.500	15.015	-.86115	9.48612	1.918	.02738	1.000	-.001	.744	.6634	R	R	1.000
7.000	16.641	.76416	9.50835	-.171	.01649	.994	-.019	.740	.6698	R	R	1.000
7.500	18.186	2.30957	9.48564	-1.480	.01240	.993	-.024	.739	.6715	R	R	1.000
8.000	19.595	3.71726	9.44072	-2.069	.00518	.994	-.019	.740	.6697	R	R	1.000
8.500	20.829	4.95081	9.39097	-2.628	.01114	1.001	.003	.745	.6618	R	R	1.000
9.000	21.867	5.98697	9.33851	-3.055	.00133	.998	-.007	.743	.6654	R	R	1.000
9.500	22.845	6.96447	9.28840	-2.743	-.00884	.995	-.017	.741	.6690	R	R	1.000
10.000	23.898	8.01645	9.24099	-2.472	-.00169	.998	-.006	.743	.6653	R	R	1.000
10.500	24.994	9.11101	9.19441	-2.416	-.00051	.999	-.004	.744	.6644	R	R	1.000
11.000	26.119	10.23502	9.14752	-2.345	-.00234	.996	-.014	.741	.6682	R	R	1.000
11.500	27.256	11.37083	9.10324	-2.087	-.00544	.990	-.033	.737	.6747	R	R	1.000
12.000	28.397	12.51103	9.06583	-1.652	-.00721	.985	-.048	.734	.6804	R	R	1.000
12.500	29.541	13.65523	9.03757	-1.180	-.00716	.982	-.057	.732	.6835	R	R	1.000
13.000	30.691	14.80461	9.01844	-.747	-.00566	.982	-.059	.731	.6842	R	R	1.000
13.500	31.846	15.96035	9.00688	-.415	-.00427	.983	-.057	.732	.6833	R	R	1.000
14.000	33.009	17.12243	9.00114	-.156	-.00358	.984	-.053	.733	.6819	R	R	1.000
14.500	34.178	18.29148	9.00000	.000	-.00000	.987	-.043	.735	.6785	R	R	1.000
15.000	35.353	19.46713	9.00000	.000	-.00000	.988	-.039	.736	.6769	R	R	1.000
15.500	36.533	20.64656	9.00000	.000	.00000	.989	-.037	.736	.6762	R	R	1.000
16.000	37.714	21.82827	9.00000	.000	.00000	.989	-.036	.736	.6758	R	R	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=FLOW (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	60.6055
LOWER BOUNDARY PRESSURE FORCE	=	.1741
UPPER BOUNDARY PRESSURE FORCE	=	-.1614
SUM OF ABOVE		60.6182
LEAVING MOMENTUM	=	60.6109
ERROR	=	.0072

********* ENDJOB *********

* * C A R D   I N P U T * *

```
NAME= FERGUSON
ADDRES= E V E N D.A L E
IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE
1 STC          F          T
$A
MACHO=.2,RM=.5,
TSO=518.688,PSO=14.69594,RG=1716.2,VMG1=100.,VMG2=100.,
NGR=2,GR(1)=.5,4.,SGR(1)=.1,4.,
NGZ=8,GZ(1)=-5.,-1.,3.,8.,8.5,8.8,10.,20.,SGZ(1)=5.,1.,.7,.2,.1,.1,.2,
10.,
MAXIT=6,PRPRN=-1,
TTE=.005,
RHL=.4,
TOLES2=.005,
$
2 BDY          BODY          EXT
$A UPPER=F,ZRONLY=F,
BL=T,
B(1)=-10.,0.,0.,
0.,0.,0.,
0.,0.,14.,
.1,.024933,14.,
.2,.049866,14.,
1.,.249328,14.,
1.6,.398925,14.,
1.7,.423858,14.,
1.8,.44879,14.,
1.9,.473631,11.294699,
2.,.489761,7.03119,
2.1,.498367,2.806544,
2.166667,.5,0.,
2.2,.5,0.,
2.3,.5,0.,
2.5,.5,0.,
5.0,.5,0.,
7.7,.5,0.,
7.8,.5,0.,
7.9,.5,0.,
8.0,.5,0.,
8.1,.498907,-1.247273,
8.2,.495677,-2.439946,
8.3,.490451,-3.522268,
8.4,.483457,-4.4499,
8.5,.475,-5.181977,
8.6,.465451,-5.687583,
8.7,.455226,-5.945697,
8.75,.45,-5.978211,
8.8,.444774,-5.945697,
8.9,.434549,-5.687588,
9.,.425,-5.181977,
9.1,.416543,-4.4499,
9.2,.409649,-3.522268,
9.3,.404323,-2.438946,
9.4,.401093,-1.247273,
9.5,.4,0.,
$
2 BDY          FF          EXT
$A
UPPER=T,ZRONLY=F,
```

```
B(1)=-10.,4.,0.,
20.,4.,0.,
$
2 BDY          CNTLN      JET
$A UPPER=F,ZRONLY=F,
B(1)=6.,0.,0.,
20.,0.,0.,
$
2 BDY          NOZZLE     JET
$A UPPER=T,ZRONLY=F,DBLPTS=0.,
BL=T,
B(1)=6.,.4,0.,
8.40000,.4,0.,
8.50000,.4,0.,
8.52000,.4,0.,
8.54000,.4,0.,
8.55000,.4,0.,
8.55976,.4,0.,
8.561982,.399985,-.788762,
8.564204,.399939,-1.57626,
8.566426,.399862,-2.36125,
8.570871,.399618,-3.918739,
8.576427,.399144,-5.829724,
8.593094,.396635,-11.15796,
8.60976,.392644,-15.586106,
8.626427,.387443,-18.86195,
8.643094,.381386,-20.859046,
8.65976,.374886,-21.528533,
8.676427,.368386,-20.859046,
8.693094,.362329,-18.86195,
8.70976,.357128,-15.586106,
8.726427,.353137,-11.15796,
8.743093,.350628,-5.829724,
8.748649,.350154,-3.918739,
8.753093,.34991,-2.36125,
8.755316,.349834,-1.57626,
8.757538,.349788,-.788762,
8.75976,.349772,0.,
8.75976,.349772,0.,
8.761982,.349788,.788762,
8.764204,.349834,1.57626,
8.766427,.34991,2.36125,
8.769727,.35008,3.5199,
8.8,.351942,3.5199,
8.85,.355048,3.5199,
8.9,.358093,3.5199,
8.95,.361169,3.5199,
9.,.364244,3.5199,
9.5,.395,3.5299,
$
3 CHN          JET
$A
AO=1.,MACHO=.2,VARY=T,
$
1 STC          T          F
$A MAXIT=6,
TOLFS2=.001,
PDUM(17)=1,
$
```

EXECUTING PROGM=STC
TAPIN= F   TAPOT= T

B O U N D A R Y   C O O R D I N A T E S,   BDY=BODY   CHN=EXT   UPPER= F   BL= T

I	X,Z	Y,R	ANGD	CURV-	CURV+
1	-10.00000	.00000	.000	.0000	.0000
2	.00000	.00000	.000	.0000*	0000.0000
3	.00000	.00000	14.000	.0000	-.0001
4	.10000	.02493	14.000	.0001	-.0001
5	.20000	.04987	14.000	.0001	.0000
6	1.00000	.24933	14.000	-.0000	-.0000
7	1.60000	.39893	14.000	.0000	-.0001
8	1.70000	.42386	14.000	.0001	.0004
9	1.80000	.44879	14.000	-.0004	-.8661
10	1.90000	.47363	11.295	1.7769	.7332
11	2.00000	.48976	7.031	.7330	.7332
12	2.10000	.49837	2.807	.7330	.7340
13	2.16667	.50000	.000	.7337	.0000
14	2.20000	.50000	.000	.0000	.0000
15	2.30000	.50000	.000	.0000	.0000
16	2.50000	.50000	.000	.0000	.0000
17	5.00000	.50000	.000	.0000	.0000
18	7.70000	.50000	.000	.0000	.0000
19	7.80000	.50000	.000	.0000	.0000
20	7.90000	.50000	.000	.0000	.0000
21	8.00000	.50000	.000	.0000	.2203
22	8.10000	.49891	-1.247	.2149	.2147
23	8.20000	.49568	-2.440	.2013	.1995
24	8.30000	.49045	-3.522	.1777	.1768
25	8.40000	.48346	-4.450	.1462	.1462
26	8.50000	.47500	-5.182	.1085	.1085
27	8.60000	.46545	-5.688	.0671	.0673
28	8.70000	.45523	-5.946	.0224	.0216
29	8.75000	.45000	-5.978	.0010	-.0010
30	8.80000	.44477	-5.946	-.0216	-.0224
31	8.90000	.43455	-5.688	-.0673	-.0671
32	9.00000	.42500	-5.182	-.1085	-.1085
33	9.10000	.41654	-4.450	-.1462	-.2057
34	9.20000	.40965	-3.522	-.1173	-.1176
35	9.30000	.40432	-2.439	-.2600	-.2006
36	9.40000	.40109	-1.247	-.2151	-.2149
37	9.50000	.40000	.000	-.2203	.0000

B O U N D A R Y   C O O R D I N A T E S,   BDY=FF   CHN=EXT   UPPER= T   BL= F

I	X,Z	Y,R	ANGD	CURV-	CURV+
1	-10.00000	4.00000	.000	.0000	.0000
2	20.00000	4.00000	.000	.0000	.0000

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

B O U N D A R Y   C O O R D I N A T E S.   BDY=CNTLN   CHN=JET   UPPER= F   BL= F

I	X.Z	Y.R	ANGD	CURV-	CURV+
1	6.00000	.00000	.000	.0000	.0000
2	20.00000	.00000	.000	.0000	.0000

B O U N D A R Y   C O O R D I N A T E S.   BDY=NOZZLE   CHN=JET   UPPER= T   BL= T

I	X.Z	Y.R	ANGD	CURV-	CURV+
1	6.00000	.40000	.000	.0000	.0000
2	8.40000	.40000	.000	.0000	.0000
3	8.50000	.40000	.000	.0000	.0000
4	8.52000	.40000	.000	.0000	.0000
5	8.54000	.40000	.000	.0000	.0000
6	8.55000	.40000	.000	.0000	.0000
7	8.55976	.40000	.000	.0000	5.8368
8	8.56198	.39998	-.789	6.5532	6.3469
9	8.56420	.39994	-1.576	6.0208	6.9128
10	8.56643	.39986	-2.361	5.4107	6.1516
11	8.57067	.39962	-3.919	6.0576	6.0172
12	8.57643	.39914	-5.830	5.9404	5.9136
13	8.59309	.39663	-11.158	5.0854	5.0777
14	8.60976	.39264	-15.586	3.9215	3.9092
15	8.62643	.38744	-18.862	2.6319	2.6213
16	8.64309	.38139	-20.859	1.3079	1.3132
17	8.65976	.37489	-21.529	-.0070	.0001
18	8.67643	.36839	-20.859	-1.3063	-1.3079
19	8.69309	.36233	-18.862	-2.6213	-2.6262
20	8.70976	.35713	-15.586	-3.9152	-3.9260
21	8.72643	.35314	-11.158	-5.0727	-5.0826
22	8.74309	.35063	-5.830	-5.9171	-5.9404
23	8.74865	.35015	-3.919	-6.0172	-6.0424
24	8.75309	.34991	-2.361	-6.1695	-6.6622
25	8.75532	.34983	-1.576	-5.6560	-6.0208
26	8.75754	.34979	-.789	-6.3469	-5.3381
27	8.75976	.34977	.000	-7.0517*0000.0000	
28	8.75976	.34977	.000	-7.0517	-7.0517
29	8.76198	.34979	.789	-5.3381	-6.3469
30	8.76420	.34983	1.576	-6.0208	-5.6560
31	8.76643	.34991	2.361	-6.6622	-6.3856
32	8.76973	.35008	3.520	-5.8522	.0008
33	8.80000	.35194	3.520	-.0008	-.0726
34	8.85000	.35505	3.520	.0726	.0729
35	8.90000	.35809	3.520	-.0729	-.0010
36	8.95000	.36117	3.520	.0010	.0013
37	9.00000	.36424	3.520	-.0013	.0007
38	9.50000	.39500	3.530	-.0014	.0000

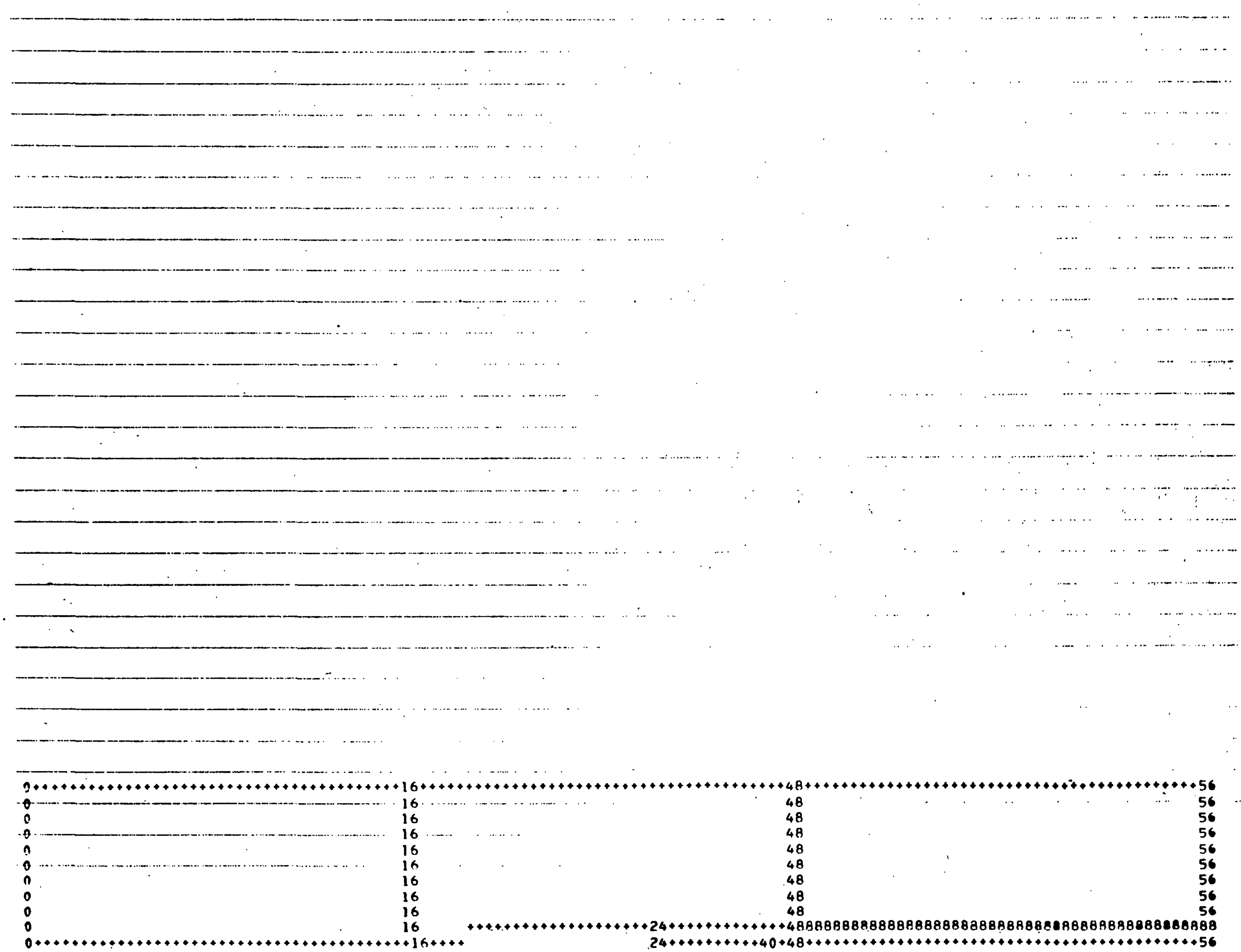
THE FAR FIELD INTERFACE BOUNDARY IS AT R= 4.000 BETWEEN Z= -10.000 AND 20.000. (BDY=FF)

EXTENDED FAR FIELD BOUNDARY

Z= -17.500 R= 4.000

Z= 27.500 R= 4.020

XI1,XI2 GRID MAP



IDENT= RFFLEXED AFTER-BODY---SUBSONIC NOZZLE

SOLUTION HISTORY

REFINEMENT		INNER ITERS		MATRIX	SOLUTION		FLOW BALANCE	ERROR		KUTTA	ITERATION	
NREFIN	GRID PTS	INRCTR	NSSPTS	NSWEEPS	MAX-DS2	MAX-ES2	LIM-ES2	Z	R	TRAILING EDGE-XI2	FLOW RATE	FRACTIONAL FLOW ERROR
0	16	0	0	0	*0.000000	.003026	1.070000	20.000	.395			
0	16	1	0	2	.007945	-.004897	1.070000	20.000	.403			
1	49	0	0	0	*0.000000	-.029339	.201893	14.750	.430	8	.0019	-.0009
1	49	1	0	6	.025763	-.006118	.201893	14.750	.406	8	.0019	-.0008
1	49	1	0	0	*0.000000	-.008700	.201893	14.750	.406	8	.0018	-.0004
1	49	1	0	0	*0.000000	-.011283	.201893	14.750	.406	8	.0018	.0000
2	100	0	0	0	*0.000000	-.033642	.105648	12.126	.316	8	.0018	-.0002
2	100	1	0	8	-.031792	-.004716	.105648	12.125	.399	8	.0018	-.0003
2	100	1	0	0	*0.000000	-.010137	.105648	12.125	.399	8	.0018	.0006
2	100	1	0	0	*0.000000	-.006485	.105648	12.125	.399	8	.0018	.0000
3	194	0	0	0	*0.000000	.029338	.053966	8.415	.319	8	.0018	-.0009
3	194	1	0	13	.025122	-.003542	.053966	10.812	.397	8	.0018	-.0002
3	194	1	0	0	*0.000000	-.004536	.053966	10.812	.397	8	.0018	-.0001
3	194	1	0	0	*0.000000	-.004841	.053966	10.812	.397	8	.0018	-.0000
4	348	0	0	0	*0.000000	.019835	.032860	8.585	.322	8	.0018	-.0000
4	348	1	0	16	.013366	-.004509	.032860	10.169	1.080	8	.0018	-.0002
4	348	1	0	0	*0.000000	-.005522	.032860	10.156	.396	8	.0018	.0001
4	348	1	0	0	*0.000000	-.004839	.032860	10.169	1.080	8	.0018	-.0001
4	348	1	0	0	*0.000000	-.004986	.032860	10.156	.396	8	.0018	.0000
5	499	0	0	0	*0.000000	-.008603	.020595	9.828	.398	8	.0018	.0001
5	499	1	0	18	.004805	-.005051	.020595	9.828	.397	8	.0018	.0003
5	499	1	0	0	*0.000000	-.004754	.020595	9.828	.397	8	.0018	.0003
5	499	1	0	0	*0.000000	-.004224	.020595	9.828	.397	8	.0018	.0002
5	499	1	0	0	*0.000000	-.003209	.020595	9.828	.397	8	.0018	.0000
6	589	0	0	0	*0.000000	-.010490	.010700	9.664	.400	8	.0018	-.0001
6	589	1	0	19	.001904	-.007483	.010700	9.664	.399	8	.0018	.0001
6	589	1	0	0	*0.000000	-.006557	.010700	9.664	.399	8	.0018	-.0000
6	589	1	0	0	*0.000000	-.006842	.010700	9.664	.399	8	.0018	.0000

*** THE INPUT GRID REFINEMENT CRITERIA HAVE NOT BEEN SATISFIED.

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IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

GENERAL INPUT-
      AXI    =        T                          MACHO =    .2000
      RG     = 1716.20                           TSO   =  518.69
      GAM    =  1.4000                           PSO   =  14.696
      TTE    =    .005                           PTO   =  15.112
      CHOTST=         T                          TTO   =  522.84
      CG     =  32.174

STREAMLINE END CONDITIONS-
      NBCIN =         2         2
      ACF   =      .000      .000

CURVATURE CALCULATION FOR SUPERSONIC FLOW-
      SSFML =         1   (FORMULA NUMBER)
      SSEANG=      .000   (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)

SUBSONIC/SUPERSONIC BRANCH SELECTION-
      SSEF   =        F   (SUPERSONIC ENTERING FLOW, T OR F)
      SSDF   =        F   (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION, T OR F)

GRID SIZE CRITERIA-
      NGR/GR=       .50     4.00
      SGR    =      .10     4.00

      NGZ/GZ=     -5.00    -1.00     3.00     8.00     8.50     8.80    10.00    20.00
      SGZ    =     5.00     1.00      .70      .20      .10      .10      .20    10.00

      VMG1   =   100.00                          VMG2  =   100.00

      CRX    =     .375     .375     .125     .000     .000     .000

MEMORY UTILIZATION-
                          USED    AVAILABLE
      GRID POINTS          589       768
      TABLES              1984      2200
      STREAMLINES           14       128

CONVERGENCE DATA-
      MAXREF=         6   (MAXIMUM REFINEMENTS)
      NREFIN=         6 - NUMBER OF REFINEMENTS
      INRCTR=         1 - NUMBER OF ITERATIONS IN LAST REFINEMENT

      TOLINR= 5.0E-02   (INNER ITERATION TOLERANCE ON S.L. MOVEMENT)
      TOLES2= 5.0E-03   (FINAL TOLERANCE ON S.L. MOVEMENT)
      TOLWF = 1.0E-03   (T.E. CLOSURE FRACTIONAL FLOW TOLERANCE)
      CLEN  =   2.140 - CHARACTERISTIC LENGTH BASED ON GRID SIZE CRITERIA
              1.1E-02 - ABSOLUTE TOLERANCE ON S.L. MOVEMENT (=TOLES2*CLEN)
      MAXES2= 6.8E-03 - LARGEST S.L. MOVEMENT ON LAST ITERATION

      DSIDMP=    .020   (STREAMWISE PT MOVEMENT DAMPING, =0 FOR NO DAMPING)
      DSIDP1=    .500   (ADDITIONAL STREAMWISE DAMPING ON FIRST PASS ONLY)
      NODENS=       0   (REFINEMENT LEVEL TO WHICH CONSTANT DENSITY IS ASSUMED)
      RHOC  =   1.000   RHOW  =  1.000   RHOCSS=  1.000   RHOWSS=  1.000   (CORRECTION EQ. DECEL. FACTORS)
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IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

SPECIAL BOUNDARY OPTIONS-
     FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
     IADM   =       0    (=-1.0.1. FOR STREAMLINE. ALTERNATING. AND ORTHOGONAL LINE RELAXATION)
     RHOBAS=     .500    (ACCELERATION FACTOR. BASE LEVEL)
     RHOAMP=     .500    (ACCELERATION FACTOR. AMPLITUDE OF VARIATION)
     TOLRL  = 1.0E-03    (TOLERANCE RELATIVE TO MAXDS2)

     HIGHLIGHT RADIUS=    .400    HIGHLIGHT AREA=    .503
     MAX. BODY RADIUS=    .500    MAX. BODY AREA=    .785
     MASS FLOW RATIO =   1.000

CONTENTS OF CHANNEL TABLE-

     CHN    =  JET        WTFLOW=  1.0000E+15
     TTO    =*0000.00     PTO    =*000.000     TSO    =*0000.00     PSO    =*000.000
     MACHO  =    .2000    AO     =  1.0000E+00 VARY   =        T
     RG     =*0000.00     GAM    =*00.0000

CHANNEL FLOW RATES. PRESSURES. AND TEMPERATURES-

                 SPECIFIED    ADJUSTED     PT/PSO      TT/TSO
     JET            .0019       .0018     15.1116    522.8375
     EXT            .1853       .1853     15.1116    522.8375
```

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

LOWER BOUNDARY TO CHN=JET • STREAMLINE COORDINATE, XI2= .000.

XI1	SIW	XW.ZW	YW.RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	COPI	(AMAX-A)/AMAX	PT/PTO
24.000	.000	6.00000	.00000	.000	.00000	1.002	.072	.974	.1926	-.0000	1.000	1.000
26.000	.346	6.34591	.00000	.000	.00000	1.002	.072	.974	.1926	-.0000	1.000	1.000
28.000	.692	6.69182	.00000	.000	.00000	1.002	.072	.974	.1926	-.0000	1.000	1.000
29.000	.865	6.86477	.00000	.000	.00000	1.002	.072	.974	.1926	-.0000	1.000	1.000
30.000	1.038	7.03773	.00000	.000	.00000	1.002	.072	.974	.1926	-.0000	1.000	1.000
31.000	1.211	7.21068	.00000	.000	.00000	1.002	.072	.974	.1926	-.0000	1.000	1.000
32.000	1.384	7.38363	.00000	.000	.00000	1.002	.072	.974	.1926	-.0000	1.000	1.000
33.000	1.557	7.55659	.00000	.000	.00000	1.002	.072	.974	.1926	-.0000	1.000	1.000
34.000	1.730	7.72955	.00000	.000	.00000	1.002	.072	.974	.1926	-.0000	1.000	1.000
35.000	1.902	7.90250	.00000	.000	.00000	1.002	.071	.974	.1927	-.0000	1.000	1.000
36.000	2.075	8.07531	.00000	.000	.00000	1.002	.070	.974	.1929	-.0000	1.000	1.000
36.500	2.162	8.16157	.00000	.000	.00000	1.002	.067	.974	.1932	-.0000	1.000	1.000
37.000	2.248	8.24750	.00000	.000	.00000	1.002	.060	.974	.1939	-.0000	1.000	1.000
37.500	2.333	8.33268	.00000	.000	.00000	1.001	.044	.974	.1955	-.0000	1.000	1.000
38.000	2.416	8.41614	.00000	.000	.00000	1.000	.011	.973	.1989	-.0000	1.000	1.000
38.500	2.496	8.49574	.00000	.000	.00000	.999	-.043	.971	.2043	-.0000	1.000	1.000
38.750	2.533	8.53309	.00000	.000	.00000	.998	-.075	.970	.2075	-.0000	1.000	1.000
39.000	2.565	8.56482	.00000	.000	.00000	.997	-.115	.969	.2113	-.0000	1.000	1.000
39.250	2.599	8.59927	.00000	.000	.00000	.996	-.158	.968	.2154	-.0000	1.000	1.000
39.500	2.641	8.64111	.00000	.000	.00000	.994	-.217	.967	.2209	-.0000	1.000	1.000
39.750	2.692	8.69206	.00000	.000	.00000	.992	-.289	.965	.2274	-.0000	1.000	1.000
40.000	2.749	8.74945	.00000	.000	.00000	.990	-.348	.963	.2326	-.0000	1.000	1.000
40.500	2.806	8.80558	.00000	.000	.00000	.989	-.386	.962	.2359	-.0000	1.000	1.000
41.000	2.857	8.85662	.00000	.000	.00000	.989	-.405	.961	.2376	-.0000	1.000	1.000
41.500	2.906	8.90559	.00000	.000	.00000	.989	-.399	.962	.2371	-.0000	1.000	1.000
42.000	2.953	8.95348	.00000	.000	.00000	.989	-.380	.962	.2355	-.0000	1.000	1.000
43.000	3.048	9.04773	.00000	.000	.00000	.991	-.319	.964	.2301	-.0000	1.000	1.000
44.000	3.141	9.14094	.00000	.000	.00000	.993	-.247	.966	.2236	-.0000	1.000	1.000
45.000	3.234	9.23373	.00000	.000	.00000	.995	-.175	.968	.2170	-.0000	1.000	1.000
46.000	3.326	9.32621	.00000	.000	.00000	.997	-.109	.970	.2108	-.0000	1.000	1.000
47.000	3.418	9.41810	.00000	.000	.00000	.998	-.055	.971	.2054	-.0000	1.000	1.000
48.000	3.509	9.50890	.00000	.000	.00000	1.000	-.011	.972	.2011	-.0000	1.000	1.000
48.125	3.665	9.66521	.00000	.000	.00000	.998	-.056	.971	.2055	-.0000	1.000	1.000
48.250	3.827	9.82656	.00000	.000	.00000	1.002	.057	.974	.1942	-.0000	1.000	1.000
48.375	3.991	9.99118	.00000	.000	.00000	1.001	.029	.973	.1970	-.0000	1.000	1.000
48.500	4.155	10.15536	.00000	.000	.00000	1.001	.025	.973	.1975	-.0000	1.000	1.000
48.750	4.484	10.48405	.00000	.000	.00000	1.000	.016	.973	.1984	-.0000	1.000	1.000
49.000	4.812	10.81229	.00000	.000	.00000	1.000	.010	.973	.1990	-.0000	1.000	1.000
50.000	6.125	12.12476	.00000	.000	.00000	1.000	.003	.973	.1997	-.0000	1.000	1.000
52.000	8.750	14.74964	.00000	.000	.00000	1.000	.000	.973	.2000	-.0000	1.000	1.000
56.000	13.999	19.99931	.00000	.000	.00000	1.000	.000	.972	.2000	-.0000	1.000	1.000

TT/TTO = 1.000

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

UPPER BOUNDARY TO CHN=JET • STREAMLINE COORDINATE. XI2= 8.000.

XII	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
24.000	.000	6.00000	.40000	.000	-.00000	1.002	.072	.974	.1926	-.0000	.360	1.000
26.000	.346	6.34591	.40000	.000	-.00000	1.002	.072	.974	.1926	.0000	.360	1.000
28.000	.692	6.69182	.40000	.000	-.00000	1.002	.072	.974	.1926	.0000	.360	1.000
29.000	.865	6.86477	.40000	.000	-.00000	1.002	.072	.974	.1926	.0000	.360	1.000
30.000	1.038	7.03773	.40000	.000	-.00000	1.002	.072	.974	.1926	.0000	.360	1.000
31.000	1.211	7.21068	.40000	.000	.00000	1.002	.072	.974	.1926	-.0000	.360	1.000
32.000	1.384	7.38364	.40000	.000	.00000	1.002	.072	.974	.1926	-.0000	.360	1.000
33.000	1.557	7.55659	.40000	.000	.00000	1.002	.072	.974	.1926	-.0000	.360	1.000
34.000	1.730	7.72955	.40000	.000	.00000	1.002	.072	.974	.1926	-.0000	.360	1.000
35.000	1.903	7.90250	.40000	.000	.00000	1.002	.072	.974	.1926	-.0000	.360	1.000
36.000	2.075	8.07546	.40000	.000	.00000	1.002	.073	.974	.1926	-.0000	.360	1.000
36.500	2.162	8.16193	.40000	.000	.00000	1.002	.074	.975	.1924	-.0000	.360	1.000
37.000	2.248	8.24841	.40000	.000	.00000	1.002	.077	.975	.1921	-.0000	.360	1.000
37.500	2.335	8.33489	.40000	.000	.00000	1.002	.084	.975	.1913	-.0000	.360	1.000
38.000	2.421	8.42137	.40000	.000	-.00000	1.003	.105	.975	.1891	.0000	.360	1.000
38.500	2.509	8.50784	.40000	.000	-.00000	1.005	.177	.977	.1813	.0000	.360	1.000
38.750	2.551	8.55108	.40000	.000	-.00000	1.007	.262	.980	.1717	.0000	.360	1.000
39.000	2.594	8.59412	.39643	-11.460	5.01019	1.011	.375	.983	.1581	.0036	.371	1.000
39.250	2.638	8.63554	.38421	-20.116	1.90619	1.004	.125	.976	.1870	.0132	.410	1.000
39.500	2.681	8.67586	.36860	-20.904	-1.26211	.989	-.388	.962	.2361	.0070	.457	1.000
39.750	2.724	8.71695	.35524	-13.804	-4.43308	.969	-1.104	.942	.2923	-.0219	.495	1.000
40.000	2.767	8.75976	.34977	.000	-4.01570	.963	-1.336	.936	.3086	-.0407	.511	1.000
40.500	2.814	8.80604	.35231	3.542	-.05508	.978	-.781	.951	.2683	-.0331	.503	1.000
41.000	2.860	8.85230	.35519	3.511	.06622	.983	-.605	.956	.2543	-.0275	.495	1.000
41.500	2.906	8.89857	.35801	3.514	-.06877	.985	-.521	.958	.2474	-.0229	.487	1.000
42.000	2.953	8.94483	.36085	3.520	.00083	.987	-.449	.960	.2414	-.0190	.479	1.000
43.000	3.045	9.03736	.36654	3.519	.00053	.990	-.342	.963	.2321	-.0124	.463	1.000
44.000	3.138	9.12989	.37223	3.517	.00015	.993	-.253	.966	.2242	-.0074	.446	1.000
45.000	3.231	9.22242	.37792	3.517	-.00023	.995	-.174	.968	.2169	-.0038	.429	1.000
46.000	3.323	9.31495	.38360	3.519	-.00062	.997	-.100	.970	.2099	-.0014	.411	1.000
47.000	3.416	9.40747	.38930	3.524	-.00100	.999	-.027	.972	.2028	-.0003	.394	1.000
48.000	3.509	9.50000	.39500	3.189	.29617	1.001	.051	.974	.1948	-.0005	.376	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	6.0000	.00000	.00000	.00000	0	.0000	.00976	.0000	.00000	.00569		.000000
2	6.3459	.00150	.00194	.01541	39564	.3459	.00753	.3459	.00184	.00494		.000000
3	6.6918	.00260	.00338	.02682	79128	.6918	.00606	.6918	.00342	.00392		.000000
4	6.8648	.00311	.00404	.03207	98910	.8648	.00577	.8648	.00404	.00362		.000000
5	7.0377	.00360	.00467	.03710	118691	1.0377	.00556	1.0377	.00467	.00360		.000000
6	7.2107	.00407	.00529	.04197	138473	1.2107	.00539	1.2107	.00529	.00350		.000000
7	7.3836	.00453	.00588	.04670	158256	1.3836	.00524	1.3836	.00588	.00340		.000000
8	7.5566	.00498	.00646	.05132	178038	1.5566	.00512	1.5566	.00646	.00332		.000000
9	7.7295	.00542	.00703	.05583	197816	1.7296	.00501	1.7295	.00703	.00326		.000001
10	7.9025	.00585	.00759	.06027	217585	1.9030	.00492	1.9025	.00759	.00324		.000013
11	8.0755	.00628	.00815	.06469	237280	2.0789	.00484	2.0755	.00815	.00331		.000151
12	8.1619	.00650	.00844	.06699	247001	2.1712	.00481	2.1619	.00844	.00342		.000659
13	8.2484	.00675	.00876	.06953	256426	2.2737	.00480	2.2484	.00874	.00368		.002606
14	8.3349	.00704	.00914	.07255	265298	2.3957	.00486	2.3349	.00908	.00614		.009869
15	8.4214	.00752	.00976	.07752	272078	2.5952	.00544	2.4214	.00980	.01624		.048658
16	8.5078	.00898	.01151	.09152	270470	3.1610	.00807	2.5078	.01188	.04946		.253454

17	8,5511	.01078	.01394	.11101	260900	3.9707	.01041	2.5511	.01457	.04998	SEP	.589833
18	8,5941	.01447	.01868	.14898	244756	5.6211	.01789	2.5943	.01621	-.02722	SEP	1.013962
19	8,6355	.00856	.01110	.08817	293115	3.0399	.00858	2.6376	.01222	-.12225	SEP	.000000
20	8,6759	.00417	.00546	.04304	372694	1.3119	-.00060	2.6808	.00563	-.10760	SEP	.000000
21	8,7170	.00223	.00294	.02301	462745	.6304	-.00052	2.7240	.00291	-.03174	SEP	.000000
22	8,7598	.00200	.00266	.02074	494235	.5606	.00739	2.7673	.00289	.01249	SEP	.000000
23	8,8060	.00332	.00437	.03430	441306	1.0178	.00427	2.8136	.00412	.02640	SEP	.448017
24	8,8523	.00405	.00533	.04193	426581	1.2971	.00545	2.8600	.00534	.01986	SEP	.361671
25	8,8986	.00454	.00594	.04682	422340	1.4735	.00546	2.9063	.00596	.01285	SEP	.319787
26	8,9448	.00500	.00654	.05159	419242	1.6538	.00533	2.9527	.00653	.01217	SEP	.319701
27	9,0374	.00584	.00763	.06028	416545	1.9906	.00519	3.0454	.00763	.01186	SEP	.332823
28	9,1299	.00669	.00872	.06895	415249	2.3353	.00512	3.1381	.00873	.01206	SEP	.349657
29	9,2224	.00758	.00987	.07812	414156	2.7081	.00508	3.2308	.00986	.01283	SEP	.371782
30	9,3149	.00854	.01111	.08803	412899	3.1196	.00511	3.3235	.01111	.01493	SEP	.400605
31	9,4075	.00966	.01255	.09955	410508	3.6078	.00526	3.4162	.01263	.01771	SEP	.445266
32	9.5000	.01108	.01439	.11423	405757	4.2435	.00513	3.5089	.01439	.02018	SEP	.495010

TOTAL FRICTION DRAG= .02047

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

UPPER BOUNDARY TO CHN=JET , STREAMLINE COORDINATE, XI2= 8.000,

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
48.000	.000	9.50000	.39500	3.189	.29617	1.001	.051	.974	.1948	-.0005	.376	1.000
48.125	.164	9.66405	.39886	-.156	.31913	1.001	.033	.973	.1967	-.0010	.364	1.000
48.250	.328	9.82808	.39629	-.801	-.16512	1.001	.042	.974	.1957	-.0007	.372	1.000
48.375	.492	9.99213	.39513	-.250	.02665	1.001	.029	.973	.1970	-.0006	.375	1.000
48.500	.656	10.15618	.39432	-.262	-.01799	1.001	.020	.973	.1980	-.0005	.378	1.000
48.750	.984	10.48428	.39347	-.075	-.00295	1.000	.014	.973	.1986	-.0005	.381	1.000
49.000	1.312	10.81238	.39317	-.041	-.00034	1.000	.010	.973	.1990	-.0005	.382	1.000
50.000	2.625	12.12480	.39248	-.019	-.00028	1.000	.003	.973	.1997	-.0004	.384	1.000
52.000	5.250	14.74964	.39226	.001	.00002	1.000	.000	.973	.2000	-.0004	.385	1.000
56.000	10.499	19.99931	.39222	-.001	.00000	1.000	.000	.972	.2000	-.0004	.385	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=JET (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	.3994
LOWER BOUNDARY PRESSURE FORCE	=	.0000
UPPER BOUNDARY PRESSURE FORCE	=	.0001
SUM OF ABOVE		.3995
LEAVING MOMENTUM	=	.3991
ERROR	=	.0004

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

LOWER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-10.00000	.00000	.000	.00000	1.000	.001	.973	.1999	-.0000	1.000	1.000
4.000	2.500	-7.50000	.00000	.000	.00000	1.000	.001	.973	.1999	-.0000	1.000	1.000
8.000	5.000	-5.00000	.00000	.000	.00000	1.000	.002	.973	.1998	-.0000	1.000	1.000
12.000	7.500	-2.50000	.00000	.000	.00000	1.000	.007	.973	.1993	-.0000	1.000	1.000
14.000	8.750	-1.25000	.00000	.000	.00000	1.001	.018	.973	.1981	-.0000	1.000	1.000
15.000	9.375	-.62500	.00000	.000	.00000	1.001	.033	.973	.1967	-.0000	1.000	1.000
16.000	10.000	.00000	.00000	.000	-.39096	1.028	1.010	1.000	.0000	-.0000	1.000	1.000
16.000	10.000	.00000	.00000	.000	-.39096	1.028	1.010	1.000	.0000	-.0000	1.000	1.000
18.000	10.598	.57986	.14458	14.000	.00000	1.003	.112	.976	.1884	.0469	.916	1.000
20.000	11.195	1.15972	.28915	14.000	-.00000	1.002	.075	.975	.1923	.0703	.666	1.000
22.000	11.793	1.73946	.43370	13.999	.00009	.998	-.075	.970	.2075	.0702	.248	1.000
24.000	12.390	2.33278	.50000	.000	.00000	.997	-.123	.969	.2121	.0457	.000	1.000
26.000	12.988	2.93033	.50000	.000	.00000	.999	-.038	.971	.2037	.0457	.000	1.000
28.000	13.586	3.52794	.50000	.000	.00000	.999	-.023	.972	.2023	.0457	.000	1.000
30.000	14.183	4.12556	.50000	.000	.00000	1.000	-.016	.972	.2016	.0457	.000	1.000
31.000	14.482	4.42436	.50000	.000	.00000	1.000	-.013	.972	.2013	.0457	.000	1.000
32.000	14.781	4.72317	.50000	.000	.00000	1.000	-.012	.972	.2012	.0457	.000	1.000
33.000	15.080	5.02198	.50000	.000	.00000	1.000	-.011	.972	.2011	.0457	.000	1.000
34.000	15.379	5.32079	.50000	.000	.00000	1.000	-.010	.972	.2010	.0457	.000	1.000
35.000	15.677	5.61960	.50000	.000	.00000	1.000	-.010	.972	.2010	.0457	.000	1.000
36.000	15.976	5.91840	.50000	.000	.00000	1.000	-.010	.972	.2010	.0457	.000	1.000
37.000	16.275	6.21721	.50000	.000	.00000	1.000	-.011	.972	.2011	.0457	.000	1.000
38.000	16.574	6.51602	.50000	.000	.00000	1.000	-.012	.972	.2012	.0457	.000	1.000
39.000	16.873	6.81483	.50000	.000	.00000	1.000	-.014	.972	.2014	.0457	.000	1.000
40.000	17.171	7.11364	.50000	.000	.00000	1.000	-.017	.972	.2017	.0457	.000	1.000
40.500	17.321	7.26304	.50000	.000	.00000	.999	-.020	.972	.2020	.0457	.000	1.000
41.000	17.470	7.41244	.50000	.000	.00000	.999	-.023	.972	.2023	.0457	.000	1.000
41.500	17.620	7.56185	.50000	.000	.00000	.999	-.030	.972	.2030	.0457	.000	1.000
42.000	17.769	7.71125	.50000	.000	.00000	.999	-.038	.971	.2038	.0457	.000	1.000
42.500	17.918	7.86066	.50000	.000	.00000	.999	-.052	.971	.2052	.0457	.000	1.000
43.000	18.068	8.01006	.49999	-.127	.21981	.997	-.098	.970	.2097	.0457	.000	1.000
43.500	18.217	8.15943	.49724	-1.965	.20679	.997	-.110	.969	.2109	.0468	.011	1.000
44.000	18.367	8.30865	.48991	-3.609	.17417	.997	-.099	.970	.2098	.0498	.040	1.000
44.500	18.516	8.45763	.47874	-4.898	.12444	.998	-.071	.971	.2070	.0535	.083	1.000
45.000	18.665	8.60639	.46481	-5.712	.06441	.999	-.034	.972	.2034	.0562	.136	1.000
45.500	18.815	8.75500	.44948	-5.978	-.00306	1.000	.004	.973	.1996	.0571	.192	1.000
46.000	18.964	8.90362	.43419	-5.673	-.06865	1.001	.040	.974	.1959	.0559	.246	1.000
46.500	19.114	9.05239	.42041	-4.825	-.12822	1.002	.068	.974	.1931	.0533	.293	1.000
47.000	19.263	9.20139	.40956	-3.513	-.11958	1.002	.080	.975	.1917	.0506	.329	1.000
47.500	19.412	9.35062	.40243	-1.846	-.20797	1.003	.092	.975	.1906	.0486	.352	1.000
48.000	19.562	9.50000	.40000	.031	-.06144	1.001	.050	.974	.1949	.0481	.360	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
8	.0000	.00000	.00000	.00000	0	.0000	.00006	10.0000	.00000	.00310		.000000
9	.5799	.00134	.00173	.01376	66902	.2988	.00152	10.5976	.00159	.00221		.000000
10	1.1597	.00211	.00273	.02170	136490	.5305	.00666	11.1952	.00264	.00145		.000000
11	1.7395	.00250	.00325	.02577	220246	.6697	.00561	11.7928	.00331	.00185		.000000
12	2.3328	.00355	.00462	.03655	299940	1.0423	.00522	12.3905	.00485	.00323		.000000
13	2.9303	.00570	.00741	.05875	360769	1.8684	.00494	12.9881	.00717	.00391		.031767
14	3.5279	.00727	.00945	.07492	429966	2.5275	.00463	13.5857	.00952	.00348		.019734

15	4.1256	.00871	.01132	.08979	499836	3.1667	.00442	14.1833	.01133	.00298	.017325
16	4.4244	.00940	.01221	.09687	534942	3.4807	.00435	14.4821	.01221	.00293	.014578
17	4.7232	.01006	.01308	.10371	570200	3.7900	.00425	14.7809	.01308	.00285	.012133
18	5.0220	.01071	.01391	.11036	605573	4.0959	.00419	15.0797	.01391	.00277	.009863
19	5.3208	.01134	.01473	.11686	641027	4.3992	.00413	15.3785	.01473	.00271	.007344
20	5.6196	.01195	.01553	.12321	676573	4.6998	.00407	15.6774	.01553	.00265	.005618
21	5.9184	.01256	.01632	.12941	712217	4.9977	.00402	15.9762	.01632	.00258	.000000
22	6.2172	.01314	.01708	.13543	748045	5.2904	.00397	16.2750	.01708	.00250	.000000
23	6.5160	.01371	.01781	.14127	784081	5.5775	.00393	16.5738	.01781	.00240	.000000
24	6.8148	.01425	.01852	.14685	820447	5.8556	.00388	16.8726	.01851	.00225	.000000
25	7.1136	.01474	.01916	.15197	857518	6.1145	.00383	17.1714	.01916	.00203	.000000
26	7.2630	.01497	.01945	.15428	876475	6.2325	.00381	17.3208	.01945	.00179	.000000
27	7.4124	.01516	.01971	.15628	895945	6.3365	.00377	17.4702	.01969	.00141	.000000
28	7.5618	.01527	.01985	.15743	916871	6.4005	.00373	17.6196	.01987	.00110	.000000
29	7.7113	.01536	.01997	.15835	938310	6.4530	.00370	17.7690	.02002	-.00074	.000000
30	7.8607	.01530	.01990	.15773	962564	6.4321	.00359	17.9184	.01965	-.00314	.000000
31	8.0101	.01451	.01888	.14956	1001411	6.0496	.00342	18.0678	.01908	-.00222	.000000
32	8.1594	.01461	.01901	.15057	1025379	6.1091	.00380	18.2172	.01899	.00308	.000000
33	8.3087	.01537	.02000	.15842	1038937	6.5014	.00402	18.3666	.02000	.00929	.009022
34	8.4576	.01673	.02176	.17247	1044021	7.2073	.00414	18.5160	.02177	.01386	.041923
35	8.6064	.01858	.02415	.19149	1044274	8.1787	.00417	18.6654	.02414	.01745	.087505
36	8.7550	.02075	.02695	.21382	1043130	9.3450	.00415	18.8148	.02698	.01975	.130963
37	8.9036	.02313	.03003	.23834	1041989	10.6558	.00403	18.9642	.03005	.01945	.160774
38	9.0524	.02535	.03290	.26122	1044523	11.9075	.00378	19.1136	.03279	.01738	.152468
39	9.2014	.02689	.03489	.27706	1054603	12.7952	.00364	19.2630	.03524	.01009	.127066
40	9.3506	.02819	.03657	.29047	1065248	13.5536	.00321	19.4125	.03581	-.00266	.131400
41	9.5000	.02653	.03444	.27341	1106096	12.6352	.00118	19.5619	.03444	.01758	.000000

TOTAL FRICTION DRAG= .04986

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

LOWER BOUNDARY TO CHN=EXT , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
48.000	.000	9.50000	.40000	.031	-.06144	1.001	.050	.974	.1949	.0481	.360	1.000
48.125	.164	9.66405	.39891	-.803	.09016	1.001	.033	.973	.1967	.0479	.363	1.000
48.250	.328	9.82808	.39629	-.801	-.10735	1.001	.042	.974	.1957	.0476	.372	1.000
48.375	.492	9.99213	.39513	-.250	.01152	1.001	.029	.973	.1970	.0475	.375	1.000
48.500	.656	10.15618	.39432	-.262	-.01524	1.001	.020	.973	.1980	.0474	.378	1.000
48.750	.984	10.48428	.39347	-.075	-.00366	1.000	.014	.973	.1986	.0474	.381	1.000
49.000	1.312	10.81238	.39317	-.041	-.00026	1.000	.010	.973	.1990	.0474	.382	1.000
50.000	2.625	12.12480	.39248	-.019	-.00030	1.000	.003	.973	.1997	.0474	.384	1.000
52.000	5.250	14.74964	.39226	.001	.00002	1.000	.000	.973	.2000	.0474	.385	1.000
56.000	10.499	19.99931	.39222	-.001	.00000	1.000	.000	.972	.2000	.0474	.385	1.000

TT/TTO = 1.000

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

UPPER BOUNDARY TO CHN=EXT , STREAMLINE COORDINATE, XI2= 16.000,

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-10.00035	4.00061	.009	.00000	1.000	.001	.973	.1999	-.0000	-63.020	1.000
4.000	2.500	-7.50049	4.00105	.012	-.00004	1.000	.001	.973	.1999	-.0000	-63.034	1.000
8.000	4.999	-5.00119	4.00186	.029	-.00019	1.000	.002	.973	.1998	-.0000	-63.059	1.000
12.000	7.495	-2.50500	4.00407	.082	-.00056	1.000	.002	.973	.1998	-.0002	-63.130	1.000
14.000	8.739	-1.26177	4.00637	.134	-.00089	1.000	.002	.973	.1998	-.0003	-63.204	1.000
15.000	9.356	-.64425	4.00799	.165	-.00087	1.000	.002	.973	.1998	-.0004	-63.256	1.000
16.000	9.964	-.03635	4.00990	.197	-.00095	1.000	.001	.973	.1999	-.0005	-63.317	1.000
18.000	10.453	.45264	4.01168	.220	-.00070	1.000	.001	.973	.1999	-.0006	-63.374	1.000
20.000	11.025	1.02487	4.01396	.234	-.00021	1.000	-.000	.972	.2000	-.0006	-63.448	1.000
22.000	11.624	1.62343	4.01641	.231	.00043	1.000	-.001	.972	.2001	-.0005	-63.526	1.000
24.000	12.292	2.29139	4.01897	.206	.00083	1.000	-.002	.972	.2002	-.0004	-63.609	1.000
26.000	12.911	2.91026	4.02103	.172	.00108	1.000	-.003	.972	.2003	-.0002	-63.675	1.000
28.000	13.517	3.51619	4.02265	.134	.00114	1.000	-.003	.972	.2003	-.0001	-63.727	1.000
30.000	14.119	4.11860	4.02386	.098	.00096	1.000	-.003	.972	.2003	.0000	-63.766	1.000
31.000	14.419	4.41903	4.02433	.082	.00091	1.000	-.003	.972	.2003	.0001	-63.781	1.000
32.000	14.720	4.71917	4.02472	.067	.00082	1.000	-.003	.972	.2003	.0001	-63.793	1.000
33.000	15.020	5.01913	4.02503	.053	.00082	1.000	-.003	.972	.2003	.0002	-63.804	1.000
34.000	15.319	5.31899	4.02527	.039	.00080	1.000	-.003	.972	.2003	.0002	-63.811	1.000
35.000	15.619	5.61880	4.02544	.025	.00075	1.000	-.003	.972	.2003	.0002	-63.817	1.000
36.000	15.919	5.91862	4.02554	.013	.00072	1.000	-.003	.972	.2003	.0002	-63.820	1.000
37.000	16.219	6.21850	4.02557	.001	.00069	1.000	-.003	.972	.2003	.0002	-63.821	1.000
38.000	16.519	6.51852	4.02554	-.011	.00067	1.000	-.003	.972	.2003	.0002	-63.820	1.000
39.000	16.819	6.81880	4.02546	-.023	.00068	1.000	-.003	.972	.2003	.0002	-63.817	1.000
40.000	17.120	7.11950	4.02530	-.035	.00070	1.000	-.003	.972	.2003	.0002	-63.812	1.000
41.000	17.421	7.42101	4.02509	-.046	.00062	1.000	-.002	.972	.2002	.0002	-63.805	1.000
42.000	17.724	7.72395	4.02482	-.056	.00051	1.000	-.002	.972	.2002	.0002	-63.797	1.000
43.000	18.029	8.02866	4.02450	-.064	.00039	1.000	-.002	.972	.2002	.0001	-63.786	1.000
44.000	18.344	8.34395	4.02413	-.069	.00024	1.000	-.002	.972	.2002	.0001	-63.775	1.000
45.000	18.654	8.65331	4.02375	-.073	.00012	1.000	-.002	.972	.2002	.0001	-63.762	1.000
46.000	18.952	8.95117	4.02337	-.074	-.00001	1.000	-.001	.972	.2001	.0001	-63.750	1.000
47.000	19.239	9.23856	4.02300	-.073	-.00009	1.000	-.001	.972	.2001	.0001	-63.738	1.000
48.000	19.521	9.52044	4.02265	-.071	-.00012	1.000	-.001	.972	.2001	.0000	-63.727	1.000
48.250	19.849	9.84873	4.02225	-.067	-.00025	1.000	-.001	.972	.2001	.0000	-63.714	1.000
48.500	20.170	10.16913	4.02189	-.063	-.00024	1.000	-.000	.972	.2000	.0000	-63.702	1.000
49.000	20.820	10.81938	4.02123	-.052	-.00035	1.000	-.000	.972	.2000	.0000	-63.681	1.000
50.000	22.128	12.12728	4.02031	-.030	-.00022	1.000	.000	.973	.2000	.0000	-63.651	1.000
52.000	24.750	14.74999	4.01950	-.009	-.00006	1.000	.000	.973	.2000	.0000	-63.626	1.000
56.000	30.000	19.99929	4.01927	.001	-.00000	1.000	.000	.972	.2000	.0000	-63.618	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=EXT (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	41.3671
LOWER BOUNDARY PRESSURE FORCE	=	-.0153
UPPER BOUNDARY PRESSURE FORCE	=	-.0000
SUM OF ABOVE		41.3518
LEAVING MOMENTUM	=	41.3671
ERROR	=	-.0153

```
EXECUTING PROGM=STC
TAPIN= T     TAPOT= F

THE FAR FIELD INTERFACE BOUNDARY IS AT R=    4.000 BETWEEN Z=  -10.000 AND   20.000.   (BDY=FF    )

*EXTENDED FAR FIELD BOUNDARY*
 Z=   -17.500   R=     4.000
 Z=    27.500   R=     4.019
```

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

SOLUTION HISTORY

REFINEMENT		INNER ITERS		MATRIX SOLUTION			FLOW BALANCE ERROR			KUTTA ITERATION		
NREFIN	GRID PTS	INRCTR	NSSPTS	NSWEEPS	MAX-DS2	MAX-ES2	LIM-ES2	Z	R	TRAILING EDGE-XI2	FLOW RATE	FRACTIONAL FLOW ERROR
6	589	0	0	0	*0.000000	.017933	.002140	9.218	.825			
6	589	1	0	38	.012976	.039071	.002140	9.674	.820			
6	589	2	0	20	-.009702	.003805	.002140	9.539	1.090			
6	589	3	0	39	.000793	-.003020	.002140	9.660	.402			
6	589	4	0	35	-.000522	-.002317	.002140	9.660	.401			
6	589	5	0	35	-.000346	-.001535	.002140	9.660	.401	8	.0018	-.0012
6	589	5	0	0	*0.000000	-.005217	.002140	9.660	.401			
6	589	6	0	22	-.003912	-.001883	.002140	9.659	.399	8	.0018	-.0001
6	589	6	0	0	*0.000000	-.002296	.002140	9.659	.399			
6	589	7	0	39	-.000597	-.001819	.002140	9.659	.399	8	.0017	-.0002
6	589	7	0	0	*0.000000	-.002475	.002140	9.659	.399			
6	589	8	0	21	-.000696	-.001453	.002140	9.659	.398	8	.0017	-.0000

*** THE INPUT GRID REFINEMENT CRITERIA HAVE NOT BEEN SATISFIED.

```
IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

GENERAL INPUT-
      AXI    =         T                                   MACHO =    .2000
      PG     = 1716.20                                     TSO   =   518.69
      GAM    =  1.4000                                     PSO   =   14.696
      TTE    =    .005                                     PTO   =   15.112
      CHOTST=         T                                    TTO   =   522.84
      CG     =  32.174

STREAMLINE END CONDITIONS-
      NBCIN =         2        2
      ACF   =      .000     .000

CURVATURE CALCULATION FOR SUPERSONIC FLOW-
      SSFML =         1    (FORMULA NUMBER)
      SSFANG=      .000    (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)

SUBSONIC/SUPERSONIC BRANCH SELECTION-
      SSEF  =         F    (SUPERSONIC ENTERING FLOW, T OR F)
      SSDF  =         F    (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION, T OR F)

GRID SIZE CRITERIA-
      NGR/GR=       .50     4.00
      SGR   =       .10     4.00

      NGZ/GZ=     -5.00    -1.00     3.00     8.00     8.50     8.80    10.00    20.00
      SGZ   =      5.00     1.00      .70      .20      .10      .10      .20    10.00

      VMG1  =    100.00                               VMG2  =   100.00

      CRX   =      .375     .375     .125     .000     .000     .000

MEMORY UTILIZATION-
                            USED    AVAILABLE
      GRID POINTS            589       768
      TABLES                2194      2200
      STREAMLINES             14       128

CONVERGENCE DATA-
      MAXREF=         6    (MAXIMUM REFINEMENTS)
      NREFIN=         6 -  NUMBER OF REFINEMENTS
      INRCTR=         8 -  NUMBER OF ITERATIONS IN LAST REFINEMENT

      TOLINR= 5.0E-02    (INNER ITERATION TOLERANCE ON S.L. MOVEMENT)
      TOLES2= 1.0E-03    (FINAL TOLERANCE ON S.L. MOVEMENT)
      TOLWF = 1.0E-03    (T.E. CLOSURE FRACTIONAL FLOW TOLERANCE)
      CLEN  =    2.140 - CHARACTERISTIC LENGTH BASED ON GRID SIZE CRITERIA
               2.1E-03 - ABSOLUTE TOLERANCE ON S.L. MOVEMENT (=TOLES2*CLEN)
      MAXES2=-1.5E-03 -  LARGEST S.L. MOVEMENT ON LAST ITERATION

      DSIDMP=      .020  (STREAMWISE PT MOVEMENT DAMPING, =0 FOR NO DAMPING)
      DSIDP1=      .500  (ADDITIONAL STREAMWISE DAMPING ON FIRST PASS ONLY)
      NODENS=         0  (REFINEMENT LEVEL TO WHICH CONSTANT DENSITY IS ASSUMED)
      RHOC  =    1.000   RHOW  =  1.000   RHOCSS=  1.000   RHOWSS=  1.000   (CORRECTION EQ. DECEL. FACTORS)
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IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

SPECIAL BOUNDARY OPTIONS-
      FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
      IADM   =        0    (=-1,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION)
      RHOBAS=     .500    (ACCELERATION FACTOR, BASE LEVEL)
      RHOAMP=     .500    (ACCELERATION FACTOR, AMPLITUDE OF VARIATION)
      TOLPL  = 1.0E-03    (TOLERANCE RELATIVE TO MAXDS2)

      HIGHLIGHT RADIUS=    .400    HIGHLIGHT AREA=    .503
      MAX, BODY RADIUS=    .500    MAX, BODY AREA=    .785
      MASS FLOW RATIO =  1.000

CONTENTS OF CHANNEL TABLE-

      CHN    =  JET        WTFLOW=  1.0000E+15
      TTO    =*0000.00     PTO    =*000.000     TSO    =*0000.00     PSO    =*000.000
      MACHO  =    .2000    AO     =  1.0000E+00 VARY   =        T
      RG     =*0000.00     GAM    =*00.0000

CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-

                 SPECIFIED     ADJUSTED      PT/PSO      TT/TSO
      JET           .0019        .0017      15.1116    522.8375
      EXT           .1853        .1853      15.1116    522.8375
```

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

LOWER BOUNDARY TO CHN=JET • STREAMLINE COORDINATE, XI2= .000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
24.000	.000	6.00000	.00000	.000	.00000	1.003	.121	.976	.1875	-.0000	1.000	1.000
26.000	.344	6.34447	.00000	.000	.00000	1.003	.104	.975	.1893	-.0000	1.000	1.000
28.000	.690	6.69014	.00000	.000	.00000	1.002	.089	.975	.1908	-.0000	1.000	1.000
29.000	.863	6.86293	.00000	.000	.00000	1.002	.083	.975	.1915	-.0000	1.000	1.000
30.000	1.036	7.03568	.00000	.000	.00000	1.002	.077	.975	.1921	-.0000	1.000	1.000
31.000	1.208	7.20843	.00000	.000	.00000	1.002	.071	.974	.1928	-.0000	1.000	1.000
32.000	1.381	7.38118	.00000	.000	.00000	1.002	.065	.974	.1934	-.0000	1.000	1.000
33.000	1.554	7.55393	.00000	.000	.00000	1.002	.059	.974	.1940	-.0000	1.000	1.000
34.000	1.727	7.72668	.00000	.000	.00000	1.001	.053	.974	.1946	-.0000	1.000	1.000
35.000	1.899	7.89939	.00000	.000	.00000	1.001	.047	.974	.1952	-.0000	1.000	1.000
36.000	2.072	8.07195	.00000	.000	.00000	1.001	.040	.974	.1960	-.0000	1.000	1.000
36.500	2.158	8.15804	.00000	.000	.00000	1.001	.033	.973	.1966	-.0000	1.000	1.000
37.000	2.244	8.24377	.00000	.000	.00000	1.001	.022	.973	.1977	-.0000	1.000	1.000
37.500	2.329	8.32859	.00000	.000	.00000	1.000	.003	.973	.1997	-.0000	1.000	1.000
38.000	2.412	8.41159	.00000	.000	.00000	.999	-.032	.972	.2032	-.0000	1.000	1.000
38.500	2.491	8.49131	.00000	.000	.00000	.998	-.086	.970	.2085	-.0000	1.000	1.000
38.750	2.530	8.53026	.00000	.000	.00000	.997	-.123	.969	.2121	-.0000	1.000	1.000
39.000	2.567	8.56702	.00000	.000	.00000	.995	-.161	.968	.2157	-.0000	1.000	1.000
39.250	2.607	8.60689	.00000	.000	.00000	.994	-.209	.967	.2201	-.0000	1.000	1.000
39.500	2.649	8.64901	.00000	.000	.00000	.993	-.261	.965	.2249	-.0000	1.000	1.000
39.750	2.696	8.69615	.00000	.000	.00000	.991	-.318	.964	.2300	-.0000	1.000	1.000
40.000	2.750	8.75017	.00000	.000	.00000	.990	-.374	.962	.2349	-.0000	1.000	1.000
40.500	2.804	8.80407	.00000	.000	.00000	.988	-.413	.961	.2382	-.0000	1.000	1.000
41.000	2.855	8.85464	.00000	.000	.00000	.988	-.429	.961	.2397	-.0000	1.000	1.000
41.500	2.904	8.90366	.00000	.000	.00000	.988	-.429	.961	.2396	-.0000	1.000	1.000
42.000	2.951	8.95149	.00000	.000	.00000	.988	-.415	.961	.2385	-.0000	1.000	1.000
43.000	3.046	9.04566	.00000	.000	.00000	.990	-.367	.963	.2343	-.0000	1.000	1.000
44.000	3.139	9.13884	.00000	.000	.00000	.991	-.305	.964	.2289	-.0000	1.000	1.000
45.000	3.232	9.23163	.00000	.000	.00000	.993	-.242	.966	.2232	-.0000	1.000	1.000
46.000	3.324	9.32432	.00000	.000	.00000	.995	-.180	.968	.2174	-.0000	1.000	1.000
47.000	3.417	9.41729	.00000	.000	.00000	.997	-.118	.969	.2116	-.0000	1.000	1.000
48.000	3.513	9.51294	.00000	.000	.00000	.998	-.057	.971	.2057	-.0000	1.000	1.000
48.125	3.663	9.66318	.00000	.000	.00000	1.002	.067	.974	.1932	-.0000	1.000	1.000
48.250	3.823	9.82283	.00000	.000	.00000	1.002	.062	.974	.1936	-.0000	1.000	1.000
48.375	3.985	9.98545	.00000	.000	.00000	1.002	.068	.974	.1930	-.0000	1.000	1.000
48.500	4.150	10.14990	.00000	.000	.00000	1.001	.046	.974	.1953	-.0000	1.000	1.000
48.750	4.479	10.47873	.00000	.000	.00000	1.001	.028	.973	.1972	-.0000	1.000	1.000
49.000	4.807	10.80734	.00000	.000	.00000	1.000	.018	.973	.1982	-.0000	1.000	1.000
50.000	6.121	12.12081	.00000	.000	.00000	1.000	.004	.973	.1996	-.0000	1.000	1.000
52.000	8.747	14.74700	.00000	.000	.00000	1.000	.001	.973	.1999	-.0000	1.000	1.000
56.000	13.999	19.99932	.00000	.000	.00000	1.000	.000	.973	.2000	-.0000	1.000	1.000

TT/TTO = 1.000

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

UPPER BOUNDARY TO CHN=JET , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
24,000	.000	6.00000	.40000	.000	-.00000	1.003	.121	.976	.1875	-.0000	.360	1.000
26,000	.345	6.34546	.39816	-.283	-.00000	1.003	.103	.975	.1893	.0007	.366	1.000
28,000	.691	6.69093	.39659	-.225	-.00000	1.002	.088	.975	.1909	.0011	.371	1.000
29,000	.864	6.86366	.39596	-.208	-.00000	1.002	.083	.975	.1915	.0013	.373	1.000
30,000	1.036	7.03639	.39533	-.206	-.00000	1.002	.076	.975	.1922	.0015	.375	1.000
31,000	1.209	7.20912	.39472	-.200	.00000	1.002	.070	.974	.1928	.0016	.377	1.000
32,000	1.382	7.38186	.39412	-.195	.00000	1.002	.065	.974	.1934	.0017	.379	1.000
33,000	1.555	7.55459	.39354	-.190	.00000	1.002	.059	.974	.1940	.0018	.380	1.000
34,000	1.727	7.72732	.39298	-.187	.00000	1.001	.053	.974	.1946	.0019	.382	1.000
35,000	1.900	7.90005	.39242	-.185	.00000	1.001	.048	.974	.1951	.0020	.384	1.000
36,000	2.073	8.07279	.39186	-.189	.00000	1.001	.043	.974	.1956	.0021	.386	1.000
36,500	2.159	8.15915	.39157	-.196	.00000	1.001	.042	.974	.1957	.0022	.387	1.000
37,000	2.246	8.24552	.39127	-.210	.00000	1.001	.043	.974	.1957	.0022	.388	1.000
37,500	2.332	8.33188	.39094	-.347	.00000	1.001	.050	.974	.1949	.0022	.389	1.000
38,000	2.418	8.41825	.39022	-.910	-.00000	1.002	.066	.974	.1932	.0024	.391	1.000
38,500	2.505	8.50459	.38820	-2.774	-.00000	1.003	.100	.975	.1896	.0029	.397	1.000
38,750	2.548	8.54769	.38562	-2.862	.00000	1.003	.125	.976	.1870	.0038	.405	1.000
39,000	2.591	8.59058	.38065	-9.749	5.06324	1.005	.162	.977	.1830	.0060	.420	1.000
39,250	2.634	8.63293	.37228	-13.134	1.89303	.999	-.045	.971	.2045	.0074	.446	1.000
39,500	2.677	8.67509	.36294	-14.755	-1.31513	.990	-.349	.963	.2327	.0020	.473	1.000
39,750	2.721	8.71693	.35225	-11.868	-4.47299	.973	-.947	.947	.2808	-.0178	.504	1.000
40,000	2.764	8.75972	.34688	-.715	-3.39177	.968	-1.137	.942	.2946	-.0334	.519	1.000
40,500	2.810	8.80606	.34820	2.031	-.05545	.979	-.739	.952	.2650	-.0300	.515	1.000
41,000	2.856	8.85238	.34985	2.372	.06664	.982	-.630	.955	.2563	-.0268	.510	1.000
41,500	2.903	8.89868	.35205	2.776	-.06826	.985	-.547	.958	.2495	-.0232	.504	1.000
42,000	2.949	8.94498	.35432	2.823	.00082	.986	-.483	.959	.2442	-.0199	.498	1.000
43,000	3.042	9.03757	.35891	2.839	.00053	.989	-.388	.962	.2362	-.0142	.485	1.000
44,000	3.135	9.13017	.36351	2.826	.00015	.991	-.311	.964	.2294	-.0096	.471	1.000
45,000	3.227	9.22276	.36806	2.782	-.00023	.993	-.243	.966	.2232	-.0059	.458	1.000
46,000	3.320	9.31536	.37251	2.664	-.00062	.995	-.180	.968	.2175	-.0031	.445	1.000
47,000	3.413	9.40797	.37667	2.509	-.00100	.996	-.135	.969	.2132	-.0011	.432	1.000
48,000	3.505	9.50060	.38062	6.623	-.52580	.997	-.117	.969	.2115	.0004	.421	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	6,0000	.00000	.00000	.00000	0	.0000	.00981	.0000	.00000	.00564		.000000
2	6,3455	.00148	.00192	.01524	38856	.3398	.00756	.3455	.00181	.00484		.000000
3	6,6909	.00254	.00330	.02622	78348	.6710	.00609	.6909	.00335	.00375		.000000
4	6,8637	.00303	.00394	.03126	98215	.8365	.00580	.8637	.00394	.00344		.000000
5	7,0364	.00349	.00453	.03600	118247	.9987	.00559	1.0364	.00453	.00339		.000000
6	7,2091	.00394	.00511	.04055	138387	1.1598	.00542	1.2091	.00511	.00325		.000000
7	7,3819	.00436	.00566	.04493	158640	1.3194	.00527	1.3819	.00566	.00314		.000000
8	7,5546	.00477	.00619	.04916	179002	1.4778	.00515	1.5546	.00619	.00304		.000000
9	7,7273	.00517	.00671	.05327	199469	1.6349	.00504	1.7273	.00671	.00296		.000000
10	7,9001	.00556	.00722	.05727	220032	1.7911	.00495	1.9001	.00722	.00292		.000000
11	8,0728	.00594	.00772	.06125	240608	1.9490	.00486	2.0728	.00772	.00297		.000000
12	8,1592	.00614	.00798	.06331	250799	2.0318	.00483	2.1592	.00798	.00317		.000000
13	8,2455	.00637	.00826	.06560	260728	2.1236	.00483	2.2455	.00827	.00383		.000316
14	8,3319	.00667	.00866	.06871	269671	2.2480	.00486	2.3319	.00864	.00548		.005899
15	8,4182	.00708	.00919	.07297	277352	2.4185	.0049-	2.4183	.00921	.00859		.024665
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.5046	.01012	.01624		.076645

17	8.5477	.00831	.01277	.08559	283193	2.9292	.00543	2.5478	.01095	.01020	.133265
18	8.5906	.00915	.01196	.09428	282006	3.2882	.00818	2.5910	.01100	-.02284	.213114
19	8.6329	.00654	.00850	.06741	319134	2.2206	.00237	2.6342	.00898	-.06248	.000000
20	8.6751	.00444	.00581	.04585	367141	1.4150	.00623	2.6774	.00561	-.06261	.000000
21	8.7169	.00255	.00336	.02631	445368	.7385	-.00020	2.7206	.00357	-.02716	.000000
22	8.7597	.00232	.00397	.02398	473051	.6650	.00661	2.7637	.00326	.00657	.000000
23	8.8061	.00343	.00451	.03542	435703	1.0568	.00481	2.8101	.00425	.02123	.325857
24	8.8524	.00394	.00517	.04065	429223	1.2454	.00556	2.8564	.00523	.01634	.261706
25	8.8987	.00440	.00576	.04539	425308	1.4204	.00542	2.9028	.00576	.01135	.272141
26	8.9450	.00481	.00630	.04964	423403	1.5804	.00529	2.9491	.00628	.01097	.267975
27	9.0376	.00554	.00725	.05719	423010	1.8717	.00513	3.0419	.00725	.01020	.281290
28	9.1302	.00626	.00817	.06455	423964	2.1624	.00505	3.1346	.00817	.01019	.296703
29	9.2228	.00699	.00912	.07208	425298	2.4659	.00498	3.2273	.00913	.01039	.314866
30	9.3154	.00775	.01010	.07991	426734	2.7876	.00483	3.3200	.01010	.00927	.314649
31	9.4080	.00839	.01093	.08652	430488	3.0646	.00462	3.4127	.01085	.00691	.261152
32	9.5006	.00874	.01138	.09015	438640	3.2197	.00453	3.5054	.01138	.00453	.209620

TOTAL FRICTION DRAG= .01995

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

UPPER BOUNDARY TO CHN=JET , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
48.000	.000	9.50060	.38062	6.623	-.52580	.997	-.117	.969	.2115	.0004	.421	1.000
48.125	.159	9.65896	.39797	1.637	1.00145	1.007	.251	.979	.1730	-.0032	.366	1.000
48.250	.324	9.82299	.39514	-.554	-.34278	1.002	.071	.974	.1927	-.0018	.375	1.000
48.375	.488	9.98711	.39357	-.529	.08445	1.002	.071	.974	.1928	-.0014	.380	1.000
48.500	.652	10.15124	.39218	-.429	-.03230	1.001	.042	.974	.1957	-.0012	.385	1.000
48.750	.980	10.47951	.39041	-.218	-.00224	1.001	.025	.973	.1975	-.0010	.390	1.000
49.000	1.308	10.80778	.38944	-.129	-.00344	1.000	.016	.973	.1983	-.0009	.393	1.000
50.000	2.621	12.12085	.38823	-.013	-.00003	1.000	.004	.973	.1996	-.0009	.397	1.000
52.000	5.248	14.74701	.38791	-.003	-.00004	1.000	.001	.973	.1999	-.0009	.398	1.000
56.000	10.500	19.99931	.38786	.001	.00000	1.000	.000	.973	.2000	-.0009	.398	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=JET (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	.3897
LOWER BOUNDARY PRESSURE FORCE	=	.0000
UPPER BOUNDARY PRESSURE FORCE	=	.0003
SUM OF ABOVE		.3900
LEAVING MOMENTUM	=	.3889
ERROR	=	.0011

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

LOWER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
,000	.000	-10.00000	.00000	.000	.00000	1.000	.001	.973	.1999	-.0000	1.000	1.000
4,000	2.500	-7.50000	.00000	.000	.00000	1.000	.001	.973	.1999	-.0000	1.000	1.000
8,000	5.000	-5.00000	.00000	.000	.00000	1.000	.002	.973	.1998	-.0000	1.000	1.000
12,000	7.500	-2.50000	.00000	.000	.00000	1.000	.008	.973	.1992	-.0000	1.000	1.000
14,000	8.750	-1.25000	.00000	.000	.00000	1.001	.019	.973	.1981	-.0000	1.000	1.000
15,000	9.375	-.62500	.00000	.000	.00000	1.001	.034	.973	.1966	-.0000	1.000	1.000
16,000	10.000	.00000	.00000	.178	-.39504	1.028	1.010	1.000	.0000	-.0000	1.000	1.000
16,000	10.000	.00000	.00000	.178	-.39504	1.028	1.010	1.000	.0000	-.0000	1.000	1.000
18,000	10.598	.57942	.14610	14.127	.00000	1.003	.114	.976	.1882	.0480	.915	1.000
20,000	11.195	1.15896	.29168	14.083	-.00000	1.002	.075	.975	.1923	.0721	.660	1.000
22,000	11.793	1.73849	.43687	14.105	.00009	.998	-.073	.971	.2072	.0727	.237	1.000
24,000	12.390	2.33158	.50486	.185	.00000	.997	-.122	.969	.2119	.0479	-.020	1.000
26,000	12.988	2.92906	.50718	.224	.00000	.999	-.038	.971	.2038	.0471	-.029	1.000
28,000	13.585	3.52661	.50953	.199	.00000	.999	-.024	.972	.2024	.0468	-.038	1.000
30,000	14.183	4.12417	.51133	.171	.00000	1.000	-.016	.972	.2016	.0467	-.046	1.000
31,000	14.482	4.42294	.51222	.168	.00000	1.000	-.014	.972	.2014	.0466	-.049	1.000
32,000	14.780	4.72172	.51308	.163	.00000	1.000	-.013	.972	.2013	.0466	-.053	1.000
33,000	15.079	5.02050	.51392	.159	.00000	1.000	-.012	.972	.2012	.0465	-.056	1.000
34,000	15.378	5.31928	.51473	.155	.00000	1.000	-.011	.972	.2011	.0465	-.060	1.000
35,000	15.677	5.61806	.51554	.152	.00000	1.000	-.011	.972	.2011	.0464	-.063	1.000
36,000	15.976	5.91683	.51632	.148	.00000	1.000	-.011	.972	.2011	.0464	-.066	1.000
37,000	16.274	6.21561	.51708	.144	.00000	1.000	-.012	.972	.2012	.0464	-.069	1.000
38,000	16.573	6.51439	.51781	.138	.00000	1.000	-.014	.972	.2014	.0463	-.073	1.000
39,000	16.872	6.81317	.51851	.129	.00000	1.000	-.016	.972	.2016	.0463	-.075	1.000
40,000	17.171	7.11195	.51916	.116	.00000	.999	-.020	.972	.2020	.0462	-.078	1.000
40,500	17.320	7.26134	.51945	.103	.00000	.999	-.023	.972	.2023	.0462	-.079	1.000
41,000	17.469	7.41073	.51969	.081	.00000	.999	-.027	.972	.2027	.0462	-.080	1.000
41,500	17.619	7.56012	.51987	.063	.00000	.999	-.033	.972	.2033	.0462	-.081	1.000
42,000	17.768	7.70951	.52002	-.043	.00000	.999	-.042	.971	.2042	.0461	-.082	1.000
42,500	17.918	7.85889	.51965	-.180	.00000	.998	-.059	.971	.2058	.0462	-.080	1.000
43,000	18.067	8.00828	.51908	-.230	.21991	.997	-.093	.970	.2092	.0464	-.078	1.000
43,500	18.216	8.15764	.51630	-1.761	.20711	.997	-.107	.970	.2105	.0476	-.066	1.000
44,000	18.366	8.30690	.51006	-3.051	.17503	.997	-.097	.970	.2095	.0502	-.041	1.000
44,500	18.515	8.45599	.50071	-4.083	.12565	.998	-.073	.971	.2073	.0534	-.003	1.000
45,000	18.665	8.60494	.48920	-4.701	.06595	.999	-.043	.971	.2043	.0560	.043	1.000
45,500	18.814	8.75380	.47670	-4.848	-.00164	1.000	-.011	.972	.2011	.0573	.091	1.000
46,000	18.963	8.90269	.46444	-4.572	-.06727	1.000	.015	.973	.1985	.0572	.137	1.000
46,500	19.113	9.05167	.45336	-3.851	-.12712	1.001	.032	.973	.1967	.0563	.178	1.000
47,000	19.262	9.20082	.44490	-2.950	-.11815	1.001	.029	.973	.1970	.0553	.208	1.000
47,500	19.412	9.35006	.43827	-2.018	-.20771	1.000	-.010	.972	.2010	.0551	.232	1.000
48,000	19.561	9.49939	.43444	-10.582	1.25059	.997	-.115	.969	.2113	.0559	.245	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
8	,0000	.00000	.00000	.00000	0	.0000	.00006	10.0000	.00000	.00310		.000000
9	,5794	.00134	.00173	.01376	66821	.2988	.00153	10.5976	.00159	.00221		.000000
10	1,1590	.00211	.00273	.02169	136426	.5303	.00665	11.1951	.00264	.00145		.000000
11	1,7385	.00251	.00326	.02583	219957	.6715	.00562	11.7927	.00332	.00184		.000000
12	2,3316	.00354	.00461	.03648	299737	1.0396	.00522	12.3902	.00484	.00318		.000000
13	2,9291	.00566	.00736	.05834	360758	1.8520	.00497	12.9878	.00712	.00384		.030884
14	3,5266	.00719	.00935	.07412	430127	2.4943	.00464	13.5854	.00943	.00361		[illegible]

15	4,1242	.00862	.01120	.08880	499092	3.1236	.00441	14.1829	.01119	.00293	.014866
16	4,4229	.00928	.01206	.09567	535109	3.4274	.00434	14.4817	.01207	.00286	.013343
17	4,7217	.00993	.01290	.10235	570400	3.7284	.00427	14.7805	.01290	.00277	.011716
18	5,0205	.01056	.01372	.10885	605784	4.0262	.00420	15.0792	.01372	.00271	.009565
19	5,3193	.01117	.01452	.11518	641263	4.3208	.00414	15.3780	.01452	.00264	.006543
20	5,6181	.01177	.01530	.12135	676851	4.6119	.00408	15.6768	.01530	.00257	.004113
21	5,9168	.01236	.01606	.12735	712572	4.8991	.00403	15.9756	.01606	.00250	.000000
22	6,2156	.01292	.01679	.13318	748469	5.1812	.00399	16.2744	.01679	.00241	.000000
23	6,5144	.01346	.01750	.13878	784630	5.4561	.00394	16.5731	.01750	.00230	.000000
24	6,8132	.01398	.01817	.14410	821206	5.7201	.00390	16.8719	.01817	.00214	.000000
25	7,1119	.01445	.01878	.14895	858532	5.9648	.00385	17.1707	.01878	.00191	.000000
26	7,2613	.01466	.01905	.15109	877695	6.0741	.00382	17.3201	.01905	.00174	.000000
27	7,4107	.01484	.01929	.15298	897311	6.1724	.00379	17.4695	.01930	.00143	.000000
28	7,5601	.01498	.01948	.15444	917735	6.2506	.00375	17.6189	.01948	.00090	.000000
29	7,7095	.01503	.01954	.15493	939969	6.2821	.00370	17.7683	.01956	-.00065	.000000
30	7,8589	.01493	.01942	.15391	965370	6.2422	.00361	17.9176	.01928	-.00228	.000000
31	8,0083	.01444	.01878	.14882	999088	6.0087	.00353	18.0670	.01888	-.00127	.000000
32	8,1576	.01450	.01888	.14954	1023571	6.0540	.00379	18.2164	.01890	.00296	.000000
33	8,3069	.01520	.01977	.15665	1037643	6.4093	.00398	18.3658	.01977	.00791	.007384
34	8,4560	.01634	.02126	.16849	1045119	7.0020	.00407	18.5152	.02127	.01154	.031972
35	8,6049	.01785	.02321	.18399	1048682	7.7886	.00408	18.6646	.02322	.01397	.066112
36	8,7538	.01957	.02543	.20172	1051006	8.7053	.00402	18.8140	.02544	.01494	.096434
37	8,9027	.02129	.02765	.21938	1055071	9.6373	.00387	18.9634	.02768	.01363	.107594
38	9,0517	.02272	.02950	.23412	1063733	10.4313	.00360	19.1128	.02951	.00860	.108642
39	9,2008	.02330	.03026	.24014	1082650	10.7713	.00324	19.2622	.03025	-.00329	.000000
40	9,3501	.02237	.02907	.23055	1121629	10.2864	.00303	19.4115	.02853	-.01698	.000000
41	9,4994	.01934	.02518	.19941	1195494	8.6836	.00026	19.5609	.02518	.00383	.000000

TOTAL FRICTION DRAG= .05115

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

LOWER BOUNDARY TO CHN=EXT , STREAMLINE COORDINATE, XI2= 8.000,

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
48,000	.000	9.49939	.43444	-10.582	1.25059	.997	-.115	.969	.2113	.0559	.245	1.000
48,125	.164	9.65896	.39801	-5.389	-1.55363	1.007	.251	.979	.1730	.0477	.366	1.000
48,250	.328	9.82299	.39514	-.554	.34166	1.002	.071	.974	.1927	.0462	.375	1.000
48,375	.492	9.98711	.39358	-.529	-.09472	1.002	.071	.974	.1928	.0459	.380	1.000
48,500	.657	10.15124	.39218	-.429	.00026	1.001	.042	.974	.1957	.0456	.385	1.000
48,750	.985	10.47951	.39041	-.218	-.01063	1.001	.025	.973	.1975	.0455	.390	1.000
49,000	1.313	10.80778	.38944	-.129	-.00254	1.000	.016	.973	.1983	.0454	.393	1.000
50,000	2.626	12.12085	.38823	-.013	-.00019	1.000	.004	.973	.1996	.0454	.397	1.000
52,000	5.252	14.74701	.38791	-.003	-.00001	1.000	.001	.973	.1999	.0454	.398	1.000
56,000	10.505	19.99931	.38786	.001	-.00000	1.000	.000	.973	.2000	.0454	.398	1.000

TT/TTO = 1.000

IDENT= REFLEXED AFTER-BODY---SUBSONIC NOZZLE

UPPER BOUNDARY TO CHN=EXT , STREAMLINE COORDINATE, XI2= 16.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
.000	.000	-10.00036	4.00063	.009	-.00000	1.000	.001	.973	.1999	-.0000	-63.020	1.000
4.000	2.500	-7.50051	4.00108	.013	-.00005	1.000	.001	.973	.1999	-.0000	-63.035	1.000
8.000	4.999	-5.00122	4.00193	.029	-.00017	1.000	.002	.973	.1998	-.0000	-63.062	1.000
12.000	7.495	-2.50514	4.00419	.085	-.00062	1.000	.002	.973	.1998	-.0002	-63.134	1.000
14.000	8.738	-1.26207	4.00659	.139	-.00089	1.000	.002	.973	.1998	-.0003	-63.211	1.000
15.000	9.356	-.64476	4.00826	.170	-.00083	1.000	.002	.973	.1998	-.0005	-63.264	1.000
16.000	9.962	-.03820	4.01021	.201	-.00100	1.000	.001	.973	.1999	-.0005	-63.327	1.000
18.000	10.449	.44881	4.01204	.226	-.00079	1.000	.001	.973	.1999	-.0006	-63.386	1.000
20.000	11.022	1.02206	4.01440	.244	-.00032	1.000	-.000	.972	.2000	-.0006	-63.462	1.000
22.000	11.619	1.61993	4.01697	.244	.00036	1.000	-.001	.972	.2001	-.0006	-63.544	1.000
24.000	12.288	2.28748	4.01969	.219	.00095	1.000	-.002	.972	.2002	-.0004	-63.632	1.000
26.000	12.906	2.90569	4.02186	.183	.00105	1.000	-.003	.972	.2003	-.0003	-63.701	1.000
28.000	13.512	3.51184	4.02360	.147	.00106	1.000	-.003	.972	.2003	-.0001	-63.757	1.000
30.000	14.115	4.11438	4.02496	.112	.00095	1.000	-.004	.972	.2004	.0000	-63.801	1.000
31.000	14.415	4.41487	4.02550	.095	.00100	1.000	-.004	.972	.2004	.0001	-63.819	1.000
32.000	14.715	4.71509	4.02595	.078	.00095	1.000	-.004	.972	.2004	.0002	-63.833	1.000
33.000	15.016	5.01513	4.02632	.062	.00092	1.000	-.004	.972	.2004	.0002	-63.845	1.000
34.000	15.315	5.31507	4.02661	.047	.00088	1.000	-.004	.972	.2004	.0002	-63.854	1.000
35.000	15.615	5.61496	4.02681	.032	.00083	1.000	-.004	.972	.2004	.0003	-63.861	1.000
36.000	15.915	5.91488	4.02694	.018	.00081	1.000	-.004	.972	.2004	.0003	-63.865	1.000
37.000	16.215	6.21488	4.02700	.005	.00077	1.000	-.004	.972	.2004	.0003	-63.867	1.000
38.000	16.515	6.51507	4.02699	-.008	.00074	1.000	-.003	.972	.2003	.0003	-63.867	1.000
39.000	16.816	6.81556	4.02692	-.021	.00071	1.000	-.003	.972	.2003	.0003	-63.864	1.000
40.000	17.117	7.11655	4.02678	-.033	.00076	1.000	-.003	.972	.2003	.0003	-63.860	1.000
41.000	17.419	7.41839	4.02657	-.046	.00073	1.000	-.003	.972	.2003	.0002	-63.853	1.000
42.000	17.722	7.72192	4.02629	-.058	.00065	1.000	-.003	.972	.2003	.0002	-63.844	1.000
43.000	18.027	8.02709	4.02595	-.070	.00071	1.000	-.002	.972	.2002	.0002	-63.833	1.000
44.000	18.341	8.34019	4.02553	-.081	.00050	1.000	-.002	.972	.2002	.0002	-63.820	1.000
45.000	18.649	8.64867	4.02507	-.089	.00038	1.000	-.002	.972	.2002	.0001	-63.805	1.000
46.000	18.949	8.94868	4.02460	-.092	.00004	1.000	-.002	.972	.2002	.0001	-63.790	1.000
47.000	19.243	9.24232	4.02412	-.092	-.00007	1.000	-.001	.972	.2001	.0001	-63.774	1.000
48.000	19.562	9.56149	4.02361	-.095	.00040	1.000	-.001	.972	.2001	.0001	-63.758	1.000
48.250	19.857	9.85635	4.02311	-.093	-.00059	1.000	-.001	.972	.2001	.0000	-63.742	1.000
48.500	20.172	10.17166	4.02263	-.084	-.00041	1.000	-.001	.972	.2001	.0000	-63.726	1.000
49.000	20.819	10.81829	4.02175	-.071	-.00034	1.000	-.000	.972	.2000	.0000	-63.698	1.000
50.000	22.125	12.12431	4.02043	-.045	-.00035	1.000	.000	.973	.2000	.0000	-63.655	1.000
52.000	24.748	14.74754	4.01926	-.013	-.00009	1.000	.000	.973	.2000	.0000	-63.618	1.000
56.000	30.000	19.99930	4.01889	.000	.00000	1.000	.000	.973	.2000	.0000	-63.606	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=EXT (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	41.3671
LOWER BOUNDARY PRESSURE FORCE	=	-.0147
UPPER BOUNDARY PRESSURE FORCE	=	-.0000
SUM OF ABOVE		41.3525
LEAVING MOMENTUM	=	41.3671
ERROR	=	-.0147

********* ENDJOB *********

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SECTION 13.0

PROGRAM INPUT SHEETS

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Overall Input Data STC/Sheet-1

∇2 input tape? T or F output tape? T or F

1 STC _____ _____

Mach number, ambient pressure and temperature, fluid properties

$A (1.) (1.) (1.) (1.4)

MACHO=________, TSO=________, PSO=________, RG=________, GAM=________,

Highlight radius, maximum body radius, body closure tolerance

RHL=________, RM=________, TTE=________,

Axisymmetric or planar?
(T) or F

AXI=__________,

spacial grid refinement criteria, see notes

GR(1)=________, ________, ________, ________, ________, ________, ________,

SGR(1)=________, ________, ________, ________, ________, ________, ________,

NGR=________,

GZ(1)=________, ________, ________, ________, ________, ________, ________,

SGZ(1)=________, ________, ________, ________, ________, ________, ________,

NGZ=________,

maximum Mach number increment between grid points

streamwise direction	normal direction
(0.1)	(0.1)

VMG1=________, VMG2=____________,

maximum number of refinements, curvature damping, incompressible start

(1.) (0)

MAXIT=________, RHOC=________, NODENS=__________,

fluid reference temperature, reference viscosity, Sutherland constant,
units conversion constant

(518.7° R) (10^{-6} lbm/in.sec) (198.6° R)

TREF=________, MUREF=________, SCON=________,

$

March 1975 Page _____ of _____.
STC/sheet-2

Boundary Coordinates

boundary name   channel name

2 4   14   24

2 BDY ________ ________

upper boundary? T or F   angle input? T-no, F-yes   boundary layer? T-yes, (F-no)   equiv. flat plate distance to boundary layer origin (0.)

$A 1 UPPER=________, ZRONLY=________, BL=________, CAPX1=________,

Z   R   ANGD

B(1)=________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,
____________, ________, ________,

$

Channel Flow Properties

channel name

2 4 14

3 CHN_________

$A

ratio of specific heats (1.4)	gas constant (1.0)	flow rate may be adjusted? (T) or F

GAM=__________, RG=____________, VARY=__________,

stagnation properties, see notes 3 and 4

total temp	total pressure

TTO=__________, PTO=______________,

Mach no.	static temp	static pressure

MACHO__________, TSO____________, PSO______________,

flow area normalized by A_{HL}

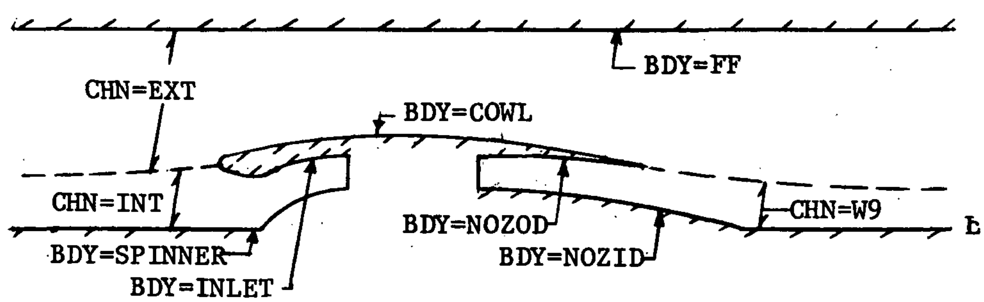
AO=________________________,

$

General Instruction and Notes for Sheet-1 of the STC Input Forms

1. The STC Program computes the subsonic and transonic field of inviscid flow past (and within) arbitrarily shaped planar and axisymmetric bodies. Inlet and exhaust nozzle flows wherein there may exist jet streams with differing energies are typical applications. An optional boundary layer analysis (SAB) is included to evaluate friction losses and displacement of the inviscid flow. Note - on Sheet-1 and the following input sheets, the values in parentheses are used if other values are not input.

2. The total flow is composed of one or more streams, the properties of which are to be listed on Sheet-3 (except as noted below). Each stream occupies a "channel" which is identified by a one to six character alphanumeric word. Each channel must be bounded, at least in part, by an "upper boundary" and a "lower boundary." Each boundary is also given an identifying one to six character name and the coordinates are listed on Sheet-2. The following sketch illustrates the naming of channels (CHN) and boundaries (BDY).



An external flow channel must be named EXT, and the recommended name for the inlet flow capture flow channel is INT. The far-field interface boundary must be named FF. Up to two arbitrary pressure or free boundaries are allowed and must be named PRES1, PRES2, FREE1, FREE2 (see Note 12). With these exceptions, the selection of channel and boundary names is arbitrary. The special channel names EXT and INT cause extra streamlines to be placed in the first refined grid. The boundary name FF indicates that the boundary condition on FF is to be obtained from an analytic far-field solution.

Program limitations preclude configurations with non-staggered leading/trailing edges (see Note 4). If a multistream case is to be analyzed, it is preferred that the low total pressure stream be the outer (or upper) channel. There are no specific limits on the number of channels or the number of boundaries. However, the total amount of data which may be input is limited by the available memory.

3. The solution method consists of constructing a grid of streamlines and orthogonal lines. Starting with two streamlines per channel (one for each boundary) and an orthogonal passing through the first and last point of each boundary, the grid is automatically refined by dividing the grid intervals in half and in half again as required. The numerical resolution, the solution accuracy and the computer execution cost are all directly related to the extent of grid refinement. The input variable MAXIT determines the maximum number of refinements. Providing this limit is not exceeded, the grid will be refined locally, as required, until the spacing of orthogonals and streamlines is less than the value determined from the SGR and SGZ tables and the Mach number difference between any two points on a streamline or an orthogonal line is less than VMG1 and VMG2, respectively. Grid size values versus radius (or y-ordinate) are to be tabulated after SGR and GR, respectively. NGR is the number of entries in each list. Grid size versus the axial coordinate is to be tabulated after SGZ and GZ, respectively. NGZ is the number of GZ values. If dimensional values of RG, TSO and PSO are input (See Note 6), then VMG1 and VMG2 must have units of velocity rather than Mach number. See supplemental notes for additional details.

   A partially refined grid may be saved on tape by specifying a T in column 24 of the first card, or read from a previously created tape by specifying a T in column 14.

   If TAPE1 and/or TAPE2 are not assigned via a REQUEST card, they are assigned to disc. This allows the user to obtain output for a given refinement level and provides the option of changing input parameters on the restart. For the restart case, specify a T in column 14 of the first data card and include in the $A list only those input quantities (viz; MAXIT) which differ from those originally input.

4. In the initial calculation grid, an orthogonal line will pass through each leading and trailing edge point and through each sharp corner point (i.e., a point on the boundary with an angle discontinuity). It is not possible to analyze a configuration in which two or more of these points are approximately opposite to each other. For example, if a configuration contains more than one leading edge, the edges must be staggered relative to the streamwise direction.

5. A free stream Mach number is specified by supplying a value of MACHØ.

6. Perfect gas assumptions are employed and the levels of ambient pressure and temperature may be dimensionless (TSO=PSO=RG=1) or dimensional. Dimensional values in a consistent set of units as described in the STC User Manual must be supplied if boundary layer calculations are requested.

7. A reference (or highlight) area is calculated from the input value of R_{HL} as follows:

axisymmetric: $A_{HL} = \pi R_{HL}^2$

planar: $A_{HL} = \Delta y_{HL} = R_{HL}$

This reference area (or Δy in the planar case) is used for defining the mass flow for each channel. See STC/Sheet-3 note 5.

8. Computed pressure drag forces are normalized by the (maximum) body area where

axisymmetric: $A_m = \pi R_m^2$

planar: $A_m = \Delta y_m = R_m$

9. Finite trailing edge thickness is permitted; the maximum thickness, or body closure tolerance, is to be supplied after TTE.

10. In some cases, it may be necessary to increase the curvature damping RHOC. RHOC is preset to unity; it should be input as 2 or more if an oscillation of MAX-ES2 is observed in the Iteration History Printout. Studies are needed to provide better guidelines for the selection of the RHOC parameter.

11. NODENS is the number of grid refinements for which the streamline positions are found by using a constant density (based on the total temperature and total pressure). This option eliminates the possibility of velocities greater than sonic and is recommended to ensure reliable starting. Example:

NODENS=2,

The default value, NODEN=0, causes the program to use the incompressible equation for the zeroth refinement only. For jet plume analysis, where adjacent streams have large differences in total pressure, NODENS =-1 is recommended.

12. Three special boundary options are provided: far-field, arbitrary pressure, and free. The far-field option may only be used for an external flow upper boundary. This will cause the numerical solution to be matched to a small perturbation analytical solution in the region from the "far-field" boundary to infinity. This boundary option is invoked by specifying the boundary name FF (See STC/Input Sheet 2. - Note 1).

An arbitrary static pressure may be specified along one or two boundaries. The input is:

NZP = ________,

ZP(1)= _____, _____, _____, _____, _____, _____, _____, _____, _____, _____,

PPS(1)= _____, _____, _____, _____, _____, _____, _____, _____, _____, _____,

NZP1 = _____, PSPISV = _____,

The allowable pressure boundary names are PRES1 and PRES2 (See STC/Input sheet 2. - Note 1).

PSP and ZP are tables of pressure versus axial distance. If there are two pressure boundaries, the values of Z and PS for the second boundary are to be included in the same ZP and PSP arrays immediately after the values for the first boundary. Also NZP1 must be defined as the number of values which apply to the first boundary. For each pressure boundary there must be at least two ZP, PSP data values and ZP must span the region in which the boundary pressure is to be controlled. The total number, NZP, cannot exceed 10.

If PPS input values are velocity rather than static pressure, then set PSPISV=1. For a jet bounded by two PRES or FREE boundaries, also specify the downstream angle: ACF(2)=_____, NBCIN(2)=1, (Refer to Note 13).

A free boundary is a constant pressure boundary which is downstream of a fixed boundary and the pressure level is the same as the pressure at the last point on the fixed boundary. Thus to use the free boundary option the contour must be input as two (or more) boundaries (see Note 2, Sheet-2). The allowable free boundary names are FREE1 and/or FREE2.

The free boundary option does not converge easily since the change in boundary pressure from one iterate to the next is not included in the streamline position correction equation.

For all of these options the approximate boundary shape must be input in the usual manner using Sheet-2. This is required to set up the initial solution grid: the boundary will then "float" in order to satisfy the specified boundary conditions. For the PRES or FREE options, it is recommended that the grid be developed by using fixed walls for the first few refinements. This may be enforced by setting NODENS=3, say, producing an incompressible grid and delaying the pressure boundary option to the fourth refinement.

13. Boundary conditions on the streamlines at the upstream and downstream boundaries may be input as follows:

Upstream: NBCIN(1)=________, ACF(1)=________,

Downstream: NBCIN(2)=________, ACF(2)=________,

NBCIN=1 if ACF is angle in degrees

=2 if ACF is curvature

NBCIN and ACF are preset to 2 and 0, respectively. This yields uniform flow with no cross stream pressure gradient. The location of the upstream and downstream boundaries are determined by where the body surface, centerline and/or far-field contours end. Since b.c. data are usually not known precisely, these contours should be extended (about one-half channel width) beyond the region of interest.

14. The fraction of unblocked circumference or lamina thickness (in the planar case) may be input in a rectangular array using the following format:

NTHKX = _______, NTHKY = ________,

THKX(1) = _____, _____, _____, _____, _____, _____, _____, _____, _____,

THKY(1) = _____, _____, _____, _____, _____, _____, _____, _____, _____,

THIK2D(1)=___, _____, _____, _____, _____, _____, _____, _____, _____,

_____, _____, _____, _____, _____, _____, _____, _____, _____,

etc.

THKX are the axial positions of the tabulated lamina thickness in the THIK2D table; list the y-variations first, i.e.,

([THIK2D(J,I),J=1,NTHKY], I=1, NTHKX)

Outside the range of THKX or THKY, the end values in the THIK2D table will be used. The THIK2D table is not extrapolated. Table size limits are as follows:

$2 \leq NTHKX \leq 25$ $1 \leq NTHKY \leq 25$ $NTHKX*NTHKY \leq 250$

15. At each level of grid refinement, a sequence of inner iterations is performed to converge the non-linear streamline position equations. Each of these inner iterations includes the evaluation of the streamline position error, ES2, and then a matrix solution of the linear correction equation for the streamline adjustment, DS2. The maximum number of inner iterations may be input as follows:

NINNER(1)=_____, _____, _____, _____, _____, _____, _____, _____, _____,

Likewise the fraction of computed DS2 actually used when moving the streamlines is:

CNVF(1)=_____, _____, _____, _____, _____, _____, _____, _____, _____,

In these tables, the index (which may go as high as MAXIT 16) is the refinement level. All values of NINNER are preset to 10 and all values of CNVF are preset to unity. NINNER and CNVF input values are seldom needed.

16. During the inner iterations, the grid points are moved in the streamwise direction to obtain an orthogonal pattern. The following streamwise damping factors are available but rarely needed:

(0) (.5)

DS1DMP=__________, DS1DP1=__________,

DS1DP1 is an additional factor on DS1DMP for the first inner iteration. Use values between zero (for no damping) and unity (for no movement).

17. Built in tolerances which may be changed by user input are as follows:

TOLES2	.001	final solution tolerance on the streamline position error, MAXES2, as determined by the flow balance routine. The input value of TOLES2 is first multiplied by the characteristic length, defined as the average of the SGR and SGZ values.
TOLWF	.001	toleance on the fractional flow adjustment needed to meet the trailing edge pressure closure condition.
TOLINR	.05	intermediate solution tolerance on streamline position error, MAXES2. This tolerance is first multiplied by the current grid size, is printed as LIM-ES2 and is satisfied (or NINNER is exceeded) before proceeding to the trailing edge pressure closure iteration or to additional grid refinements.
TOLRL	.001	matrix solution tolerance on the sweep-to-sweep change in DS2 divided by maximum DS2.

18. Miscellaneous input items:

PRPRN = c
= (0) for a, b & c
= -1 for b & c

code: a - flow properties at all grid points printed

b - flow properties along boundaries printed.

c- flow properties along approach and trailing streamlines printed.

CHOTST = T (preset value)
= F to delete the check for choking when iterating for trailing edge pressure closure, set to False only for low speed flows to reduce execution time

19. Boundary layer calculations are normally specified using the input given on STC/Input Sheet-2. In some cases it is desirable to introduce boundary layers into a fully converged STC inviscid solution. This may be conveniently done on restart by specifying INPBL as the total number of surfaces for which a boundary layer calculation is desired. The boundary names and initial X's (CAPX1) are given on fixed format cards immediately following the $A NAME LIST. The format of these cards is as follows:

Column 2-7 Boundary name (1-6 alphanumeric characters)

Column 12-21 Equivalent flat plate distance from boundary layer origin to the first calculated boundary layer point (F10.6 format).

Example:

```
$A
:                                       Restart Input
INPBL=2,
:
$
2         12
BDY1      0o
BDY2      1.632
```

20. For boundary layer cases, supply a reference temperature, reference viscosity and a Sutherland constant if different from air values. The following sets of units may be used:

Units

Parameter	Dimensionless (STC)	English (in.)	English (ft.)	MKS
L	any	in.	ft.	m
PSO, PTO	*atm	psia	psfa	N/m^2
TSO, TTO	*atm	°R	°R	°K
TREF	-	°R	°R	°K
MUREF	-	lbm/in.sec	lbm/ft.sec	kg/m.sec
SCON	-	°R	°R	°K
RG	1	ft^2/sec^2° R	ft^2/sec^2° R	J/kg °K
CG	-	ft-lbm/$lb_f sec^2$	ft-lbm/$lb_f sec^2$	(unity)
VMG1,VMG2	**	ft/sec	ft/sec	m/sec

*atm - Normalized by ambient conditions

** - Dimensionless (values are approximately equal to a Mach number difference)

Notes for Sheet-2 of the STC Input Forms

1. Use one of these sheets for each boundary. Supply a one to six character name to identify the boundary in column 14 of the first card. Special boundary names are: /FF - Far-field/, /PRES1, PRES2 - Arbitrary pressure/, /FREE1, FREE2 - Free/. (See Note 12 - STC/Input Sheet 1). Also indicate the name of the channel to which the boundary is adjacent in column 24. On the second card indicate whether the boundary is above (UPPER = T) or below (UPPER = F) the channel.

2. The upper or lower "contour" which bounds a given stream may be composed of several "boundaries." In this case, an input sheet must be completed for each boundary; the last point of the first boundary must have the same coordinates as the first point of the second boundary, and so forth. This option is useful when considering variable geometry configurations such as flaps or movable nozzle parts. The movable part may be translated and rotated, as indicated by Note 8, while the fixed part is held stationary.

3. List values of Z (or X), R (or Y) and the surface angle in degrees at discrete points along this boundary contour after the symbol "B(1)=". Points at sharp corners must be listed twice, one time for each angle which exists at that point. In each interval, the STC Program fits a locally rotated cubic polynomial. The input points must be smooth and consistent with the specified angles.

All points are to be listed in the streamwise direction. For an inlet lip, the points are listed by starting at the highlight point and then proceeding around the nose to the trailing edge or downstream boundary. The internal and external surfaces are listed separately under different boundary names. However, the coordinates of the first point must be the same with ANGD equal to +90° for the external surface and -90° for the internal surface.

It is recommended that the boundary coordinates and angles be obtained from an analytic definition of the contour, and that around the nose, angle variations between points be 20° or less.

4. Pressure and Mach number distribution data will be printed at each orthogonal intersection with the boundary, and not at each input boundary point. Orthogonal stations, however, will be placed at any repeated point in the boundary table. List the same points twice if it is desired to have an orthogonal placed in that position. (This option is modified slightly when ZRONLY = T.) Orthogonal stations are always placed at the beginning and end of a boundary and at a juncture point between boundaries along the same contour.

5. If the coordinates but not the angles are known, the third column in the B-input array may be omitted. In this case specify ZRONLY = T and list the coordinates twice at any point where a curvature jump or an angle jump exists. The double points will later be deleted if the angle discontinuity is less than 0.01 degrees. These double points are removed because extra calculation stations are usually not desired at such points. However, the double point angle tolerance, DBLPTS, preset as 0.01, may be input as zero if such double points are to be retained.

6. With either input option, care must be taken to specify the coordinates with precision. The round off or reading error of the coordinate data should be less than $\Delta S^2/(10*L)$, where ΔS is the local distance between points and L is some characteristic length, say the length of the cowl. Conversely, the spacing between points should not be less than $(10\ \delta L)^{1/2}$ where δ is the relative accuracy of the coordinate data. The tabulated output curvatures may be consulted to verify the smoothness of the input data.

7. NACA Series 1 Cowl coordinates are stored internally. With the ZRONLY = T option they may be selected by listing:

B(1) = 991, 1,

X_1, Y_1, Series 1 Segment

Y_2, Y_2,

X_2, Y_2

___,___, Cowl Aft Segment

where X_1, Y_1 are the highlight coordinates and X_2, Y_2 is the position of the maximum diameter at the end of the Series 1 contour segment.

8. The input coordinates of a boundary may be adjusted by supplying the following input quantities not shown on the front of this sheet:

ROTATE	angular rotation in degrees
ZPIVOT RPIVOT	pivot coordinates
SCALE	multiplicative constant to be applied to the coordinate data
ZTRANS	translation increment in the axial direction
RTRANS	translation on increment in the radial/vertical direction

The order of transformation is rotation, scaling and translation. Hence, the pivot coordinates are in the samc coordinate frame as the input data and the translation increments are in the rotated coordinate frame after scaling. It is only necessary to input data for the transformation operations to be executed.

9. The normal option assumes no boundary layer (BL = F). If a boundary layer calculation is desired, input BL = T. Also, supply an initial "equivalent" fat plate distance for the boundary layer origin to the first calculation station if different from 0. (stagnation point)

$$\mathrm{CAPX1} = \frac{\pm 1}{R_1 P_1{}^a} \int_{S_{orig}}^{S_1} RP^a dS$$

$$P = \left[\frac{M}{1+.2M^2}\right]^4$$

$$a = 1.25 \quad Rex_1 \approx 10^6$$

$$1.2 \quad Rex_1 \approx 10^7$$

Notes for Sheet-3 of the STC Input Forms

1. Use one of these sheets for each channel to supply entrance flow properties. (See exception under Note 5.)

2. Of the input items shown on the face of the input sheet, use only those which are required for the selected options.

3. The total pressure and total temperature may be input by either of the following two procedures:

   a. Specify TTO and PTO if the stagnation properties are known. These values may be normalized by the free stream ambient temperature and pressure.

   b. Specify MACHO, TSO and PSO if the static properties and Mach number are known. Again TSO and PSO may be normalized by the free stream ambient values. If only MACHO is supplied (TSO and PSO are omitted), the TSO and PSO values from STC/Sheet-1 will be used.

   If neither of the above is input, free stream values as supplied on Sheet-1 are used for MACHO, PTO and TTO.

4. If the gas constant, RG, is different from the value supplied on STC/Sheet-1, supply the value which applies to this channel. RG, TSO, TTO, PSO and PTO may all be given as dimensionless (normalized by free stream ambient) or dimensional using a consistent set of units.

5. Input a value AO for the determination of the channel flow rate. AO is an area fraction normalized by A_{HL} as defined under Note 7 of Sheet-1; the (dimensional) channel flow area is then the product $AO*A_{HL}$. The flow rate for the channel is computed by using one-dimensional relations from the total properties (as determined under Notes 3 and 4), the supplied Mach number, MACHO, and the flow area. For internal inlet channels, specify R_{HL} as the highlight radius and AO as the mass flow ratio.

6. If for any channel the input data on this sheet is not supplied, the reference properties on STC/Sheet-1 will be employed and the frontal area calculated at the entrance station will be used. This option is suggested for an external stream.

7. Although approximate flow rates must always be supplied according to Note 5, the program will adjust channel flow rates as required to meet the zero pressure loading conditions at a trailing edge or to meet a maximum (choked) flow rate. The number of channels which require flow rate adjustment is equal to the number of trailing edges. If the flow rate is not to be varied for this channel, specify VARY = F.

Grid Refinement Criteria - Supplemental Notes

One of the important controls that the user should exercise in operating the STC program is the Grid Refinement Specification. In simpliest terms the user is required to input the following three quantities:

SGR =	______,	Nominal distance between streamlines and between orthogonal lines
VMG1 =	______,	Nominal Mach number (velocity) difference between points along a streamline
VMG2 =	______,	Nominal Mach number (velocity) difference between points along an orthogonal line

Note, if dimensional values of the perfect gas constant and temperature are input then VMG1 and VMG2 are velocity differences; otherwise VMG1 and VMG2 are to be input as a Mach number difference.

To illustrate the function of these input items, consider the question of whether or not a new orthogonal line should be inserted between existing orthogonals as shown in Figure 30. To answer this question, the program computes, say, between the (i) and (i+1) orthogonals, the following quantities at each streamline:

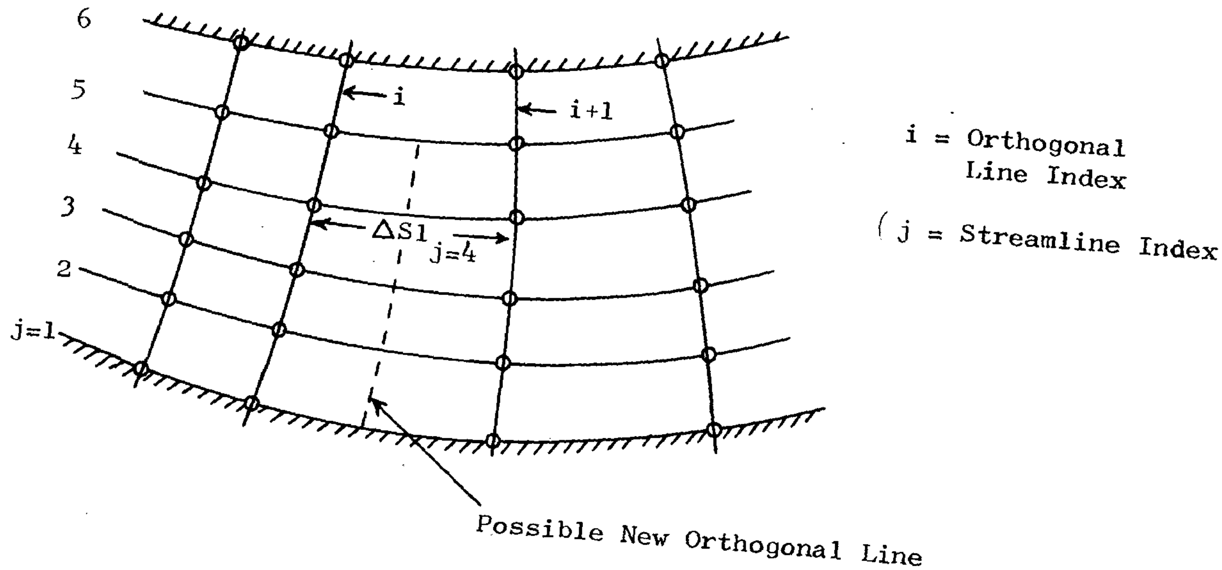
$$R_{s_j} = \frac{\Delta S1_j}{SG} \qquad (SG = SGR) \tag{1a}$$

$$R_{v_j} = \frac{|V_{i+1,j} - V_{i,j}|}{VMG1} \qquad j = 1,2,3,\text{-- ---} \tag{1b}$$

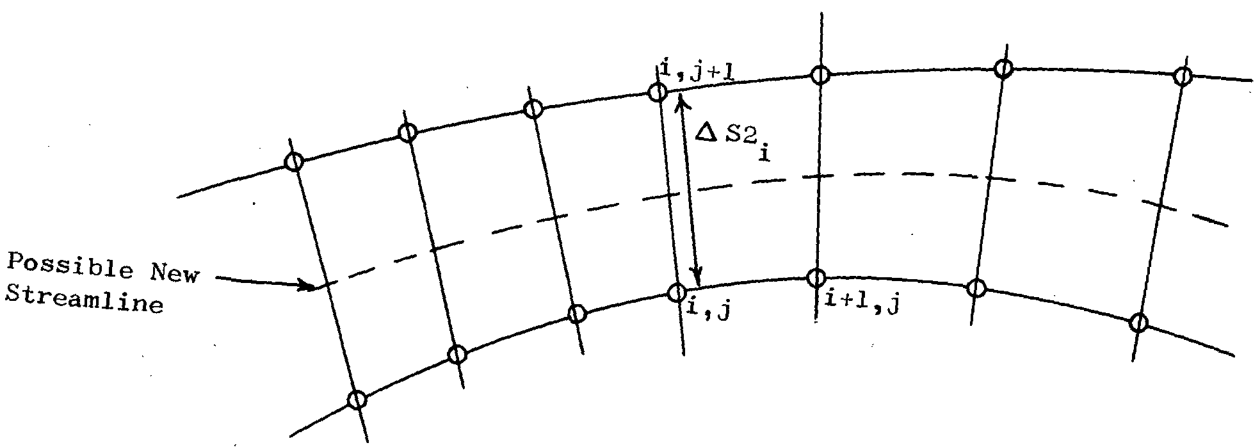
Figuratively speaking, these values are then plotted on Figure 31.

If all the Rs_j, Rv_j points fall outside of Region (1) a new orthogonal will not be inserted into the i,i+1 interval. But if one or more points do fall in Region (1), a new orthogonal is required. The new line will be extended to all streamlines for which the Rs_j, Rv_j values fall in Region (2), or to a minimum of five streamlines.

Thus, according to the criteria illustrated in Figure 31, the maximum distance between any two points along a streamline is SG (=SGR). If a velocity gradient exists along the streamline, the maximum distance between points is reduced. When the spacing ratio Rs becomes very small (Rs < 0.24) relatively large velocity differences between points is allowed, a feature which is intended to eliminate excessive refinement near stagnation points.



(a) New Orthogonal Line



(b) New Streamline

Figure 30. Insertion of a New Streamline and Orthogonal Line.

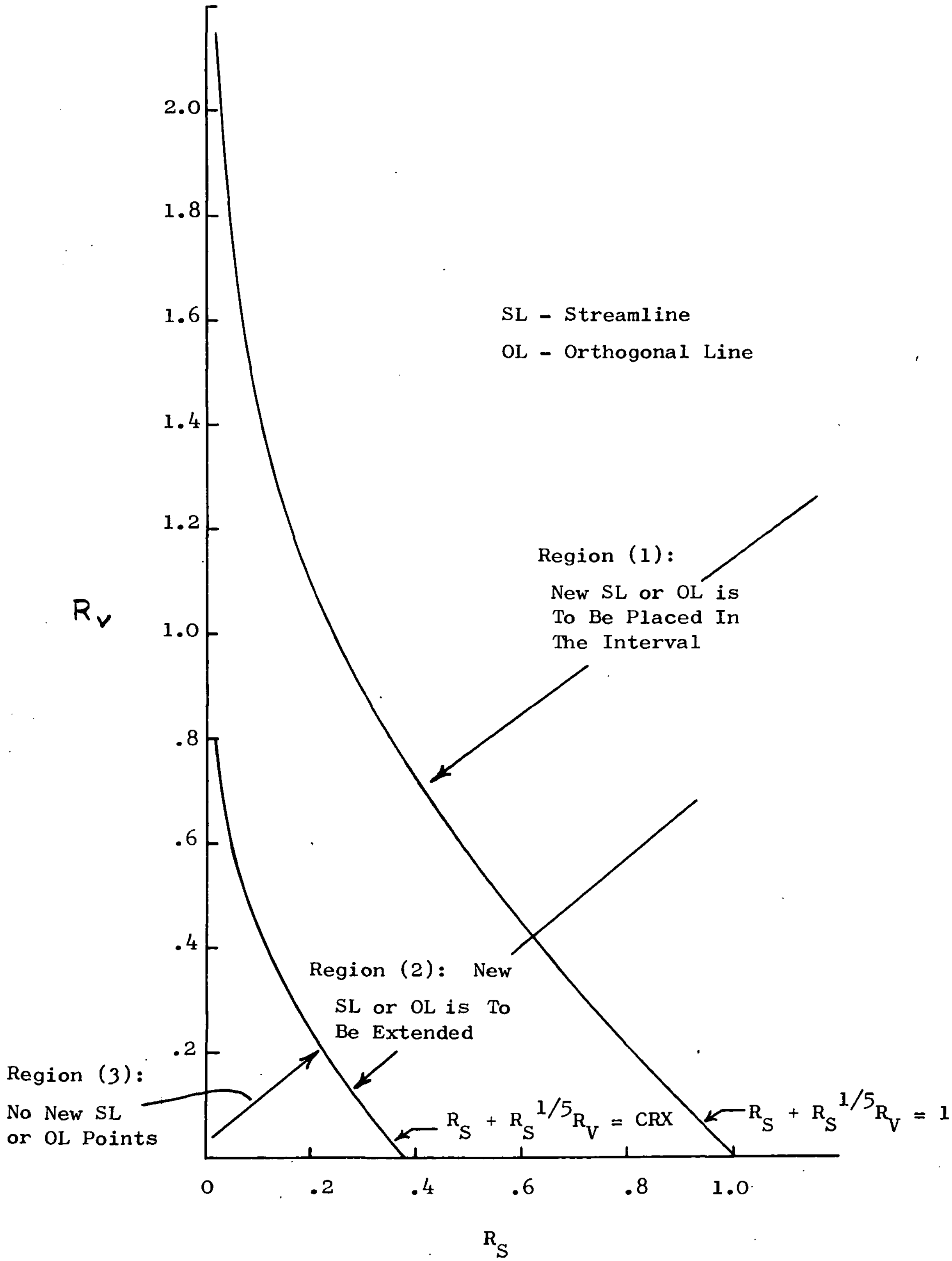


Figure 31. Grid Refinement Criteria.

A similar criteria is used for determining when additional streamlines are required. The only variation is that Equations (1a) and (1b) are replaced by Equations (2a) and (2b):

$$R_{s_i} = \frac{\Delta S2i}{SG} \qquad (SG = SGZ) \qquad (2a)$$

$$R_{v_i} = \frac{|V_{i,j+1} - V_{i,J}|}{VMG2} \qquad i = 1,2,3, \text{-----} \qquad (2b)$$

Streamlines and orthogonal lines are inserted until the above criteria are satisfied (or until the number of refinements equals MAXIT). The internal values of VMG1 and VMG2 (0.1) are appropriate for most configurations, and unless these values are to be altered the VMG1 and VMG2 input may be omitted. However, the user must always supply a value for SGR. In selecting this value care must be taken without sacrificing computing efficiency with an excessive number of grid points.

As a guide to the selection of SGR it is suggested that SGR be set to about twice the expected grid spacing. Because new grid intervals are always obtained by halving existing grid intervals, the average grid size will be less than that required to satisfy the criteria given in Figure 31.

Spatial Variation of Grid Size

For external flow problems, and some internal problems as well, it is necessary to input a spatial grid size variation. The additional input required is:

GR(1) = _____, _____, _____, _____, _____, _____,

SGR(1)= _____, _____, _____, _____, _____, _____,

GZ(1) = _____, _____, _____, _____, _____, _____,

SGZ(1)= _____, _____, _____, _____, _____, _____,

GR and SGR is a table of grid size (SGR) with radius (GR); likewise GZ and SGZ is a table of grid size (GZ) with axial position (SGZ). The value of SG in Equations (1a) and (2a) at any point, z,r, is then taken as the maximum of the SG's found by linear interpolation in the two tables of radial and axial variations.

Special rules which apply to these input items are as follows:

1) If a radial variation (but not axial variation) of grid size is desired, the user must input pairs of values in the SGR and GR lists. GR must be in ascending order. If grid size information is required beyond the limits of the input table, the closest

values will be used. Also if the grid size is to be constant with radius no GR input is required and only one value of SGR need be supplied.

2) If an axial variation (but no radial variation) of grid size is desired, the user must supply pairs of values in the SGZ and GZ lists. Also he must input one value of SGR which is the minimum of the SGZ values.

3) If both an axial and radial variation of grid size is desired, he should supply appropriate values in both tables. Remember that for any point, r,z, the r-coordinate will be used to obtain a grid size from the GR,SGR table and the z-coordinate will be used to interpolate in the GZ,SGZ table. The maximum of the two interpolated values will then be used in Equations (1a) and (2a) Generally, the SGR and SGZ values are set to small values close to a body, or region of interest, and increased to larger values as one moves away from the body.

Input Control of "Partial" Grid Lines

As noted previously, new orthogonal lines and streamlines are not necessarily extended to the field boundary. Instead, the length of these lines is determined by the size of Region (2) in Figure 31. Notice the Region (2) is increased, and the length of the new grid lines is likewise increased, if CRX, the constant in the equation defining the lower boundary of the region, is decreased. If CRX = 0, then all new grid lines will span the field; that is, full grid lines rather than "partial" grid lines will be inserted.

Values of CRX are preset, but they may be altered by input cards as follows:

Input Name (a)	(b)	Preset Value	Used for Extending
CRX(1)	CRXSL	.375	New Streamlines
CRX(2)	CRXOL	.375	New orthogonal lines across a subsonic region
CRX(3)	CRXSS	.125	New orthogonal lines across a supersonic or mixed flow region
CRX(4)	CRXE	0	New orthogonal lines which cross a sonic line
CRX(5)	CRXC	0	New orthogonal lines which cross a supersonic to subsonic compression line

If two or more of the above values apply, the smaller value will be used.

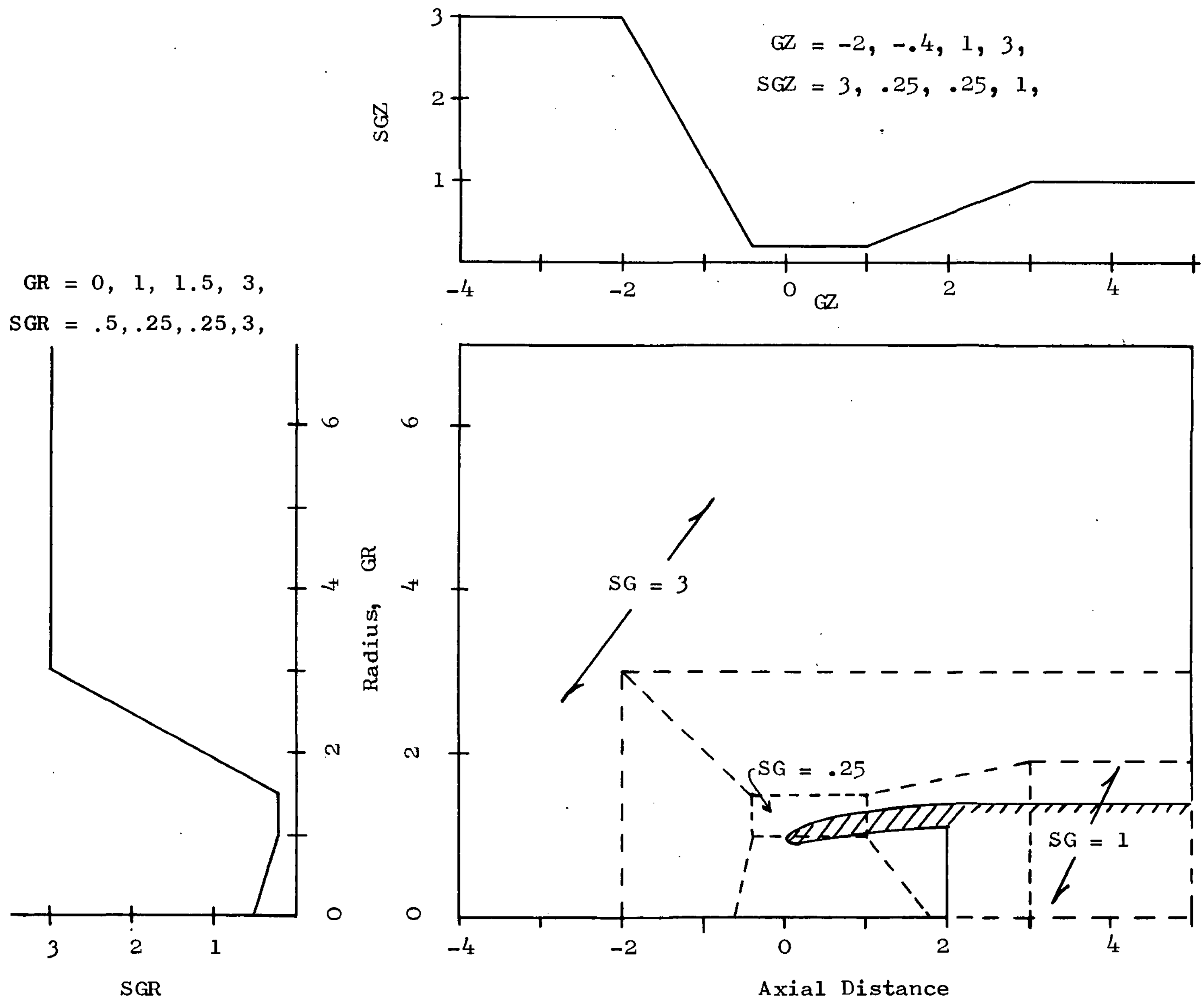


Figure 32. Typical Spacial Grid Size Specification for an Inlet Analysis.

Recommended Spatial Grid Variation for an Inlet Configuration

Typical input for the spatial variation of grid size for an inlet configuration is given in Figure 32. In this case all dimensions are normalized by the highlight radius. The quoted values of SGR, GR, SGZ, GZ should be scaled by the highlight radius for a given problem. Notice that the combination of the axial and radial variations yields contours of grid size which are roughly centered about the leading edge.

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APPENDIX A

LOWER BOUNDARY CORRECTION EQUATION FOR VELOCITY B.C.

Continuity form of correction equation for first streamtube: (See Equation 94 of Reference 1)

$$(\rho V)_{1.5}\,[\delta A_2 - \delta A_1] + [A_{02} - A_{01}]\,\delta(\rho V)_{1.5} = (\rho V)_{1.5}\,[(A_X - A_0)_2 - (A_X - A_0)_1] \tag{1}$$

We need now an expression for $\delta(\rho V)_{1.5}$. From Equation 105 of Reference 1 we have

$$\delta(\rho V)_{1.5} = \beta_{1.5}^{2}\rho_{1.5}\delta V_{1.5} \tag{2}$$

From Equation 95 of Reference 1 we have

$$\delta V_{1.5} = \delta V_1 + \delta\,(V_{1.5} - V_1) \tag{3}$$

so

$$\delta(\rho V)_{1.5} = \beta_{1.5}^{2}\rho_{1.5}[\delta V_1 + \delta(V_{1.5} - V_1)] \tag{4}$$

To evaluate $(V_{1.5} - V_1)$ use the cross stream momentum equation, $\frac{1}{V}\frac{\partial V}{\partial n} = -C$ Again following Equation 99 we can write

$$V_{1.5} - V_1 = -\frac{1}{2}V_{1.5}\,(n_2 - n_1)\,C_{1.5} \tag{5}$$

An approximate variational form of the above is:

$$\delta(V_{1.5} - V_1) = \frac{1}{2}V_{1.5}\,(n_2 - n_1)\,\delta C_1 \tag{6}$$

Here, we assume $\delta c_{1.5} \approx \delta c_1$ and that

$$\frac{\delta[V_{1.5}(n_2 - n_1)]}{V_{1.5}(n_2 - n_1)} << \frac{\delta C_{1.5}}{C_{1.5}} \tag{7}$$

Equation [6] substituted into [4] gives

$$\delta(\rho V)_{1.5} = \beta_{1.5}^{2} \rho_{1.5}[\delta V_1 - \frac{1}{2} V_{1.5}(n_2 - n_1)\ \delta C_1] \tag{8}$$

And substitution of [8] into [1] gives

$$\delta A_2 - \delta A_1 + [A_{02} - A_{01}] \frac{\beta_{1.5}^{2}}{V_{1.5}} [\delta V_1 - \frac{1}{2} V_{1.5}(n_2 - n_1)\ \delta C_1] \tag{9}$$

$$= (A_X = A_0)_2 - (A_X - A_0)_1$$

Rearranging

$$[\delta A_2 - \delta A_1] + \frac{1}{2}(A_{02} - A_{01})\ \beta_{1.5}^{2}\ (n_2 - n_1)\ [-\delta C_1] \tag{10}$$

$$= (A_X - A_0)_2 - (A_X - A_0)_1 - (A_{02} - A_{01})\ \beta_{1.5} \frac{\delta V_1}{V_{1.5}}$$

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